

# The role of belief in the regulation and reporting of memories

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# The Role of Belief in the Regulation and Reporting of Memories

Andrew Clark

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# The Role of Belief in the Regulation and Reporting of Memories

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by

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# Abstract

Recent research demonstrates that believing that an event occurred and recollecting an event are distinct components of remembering the past. The over-arching aim of this thesis was to examine whether omission errors in memory reports can be explained by the attenuation of belief in those memories. Specifically, we examined whether omission errors are characterised by lower belief ratings. Previous research suggests that omission errors can be elicited using suggestive and misleading post-event information. Factors such as social feedback, contradictory evidence and event implausibility are also commonly reported reasons for people attenuating their belief that events in their past actually occurred. In **Experiments 1 and 2**, we sought to elicit omission errors using a procedure adapted from Wright et al. (2001). Participants saw a number of scenes, each showing a collection of household items. After a free recall test where participants had to recall as many items as they could from each scene, participants were either re-presented with the scenes (Expt. 1) or the experimenter read aloud to the participants the items they had recalled (Expt. 2). In these re-presented scenes, some of the items which were originally presented to the participants were withheld. The results showed that re-presenting participants with either the original stimuli (Expt. 1) or repeating back to participants the items they had recalled (Expt. 2) with some items withheld, did not result in participants attenuating their belief that they had previously seen these items. Furthermore, we did not find substantial evidence that these items were even omitted (at a higher rate) as predicted from previous research (Wright et al., 2001). In **Experiments 3 and 4**, participants' memories of items (Expt. 3) or actions (Expt. 4) were challenged by a confederate (Expt. 3 & 4), or by the experimenter (Expt. 4) providing social feedback. The results showed that social feedback resulted in omission errors and the attenuation of belief. However, we also found that memory ratings for omitted memories were lower than reported memories. In the discussion of our results, we highlight the important link between social feedback, omission errors and the attenuation of belief.



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*Experiments 3 and 4 (Chapter 3) were presented at the International Conference on Memory in June 2016:*

Clark, A., Hope, L., Otgaar, H., Ost, J., Sauer, J., Merckelbach, H., Kontogianni, F., & Pedrero Núñez, R. The consequences of not believing: Nonbelieved memories are not precursors to memory omission errors. Presentation at the International Conference on Memory, Budapest, Hungary. (July 2016)

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# Chapter 1

## Introduction to the Thesis





## INTRODUCTION

Human memory is as remarkable as it is complex. In an attempt to understand how our memory works, memory is often described as being comprised of three stages. The first of these three stages is *encoding*, where we acquire the information which is to be remembered. The second stage is concerned with the *storage* of this information in our memory system. The final stage of remembering is *retrieval*, concerned with retrieving the information from the memory system. We must first acquire the information, retain it, and we must be able to gain access to this information when it is required. These different stages represent the basic processes involved in remembering.

Psychologists are predominantly concerned with encoding and retrieval mechanisms when examining human memory. Researchers have examined a number of factors, occurring at encoding and retrieval, which can impact the way people remember pieces of information. For example, in the eyewitness memory literature, research has demonstrated that participants' memories for details of an event are often impaired when there is a weapon present at encoding, known as the weapon focus effect (see Fawcett, Russell, Peace, & Christie, 2013). Research has also found that participants who are induced into a state of stress at retrieval show poorer memory performance compared with participants who are not in a stress state (Smeets, Otgaar, Candel, & Wolf, 2008). These findings demonstrate that memory performance can be impaired by factors at encoding and retrieval.

Endel Tulving once described retrieval as the most important of the three memory stages of remembering (Gazzaniga, 1991). Of course, encoding and storing information into memory seems rather pointless without a way of gaining access to this information when it is required. Retrieval is perhaps the most common process people associate with memory. We have all experienced being unable to remember something (e.g., where did I leave my keys?) and the frustration that comes with being unable to retrieve a memory. Attempting to retrieve information from memory can have four possible outcomes. This can be viewed as a 2 (encoded vs. not encoded) x 2 (retrieved vs. not retrieved) matrix. Encoded information can either be retrieved, what might be called perfect remembering; or fail to be retrieved, most often attributed to forgetting, but as will be discussed later, can also occur as a result of misleading and erroneous information. When people do not report information that was encoded, then people "suffer" from so-called omission errors. Misleading information can also cause people to report erroneous or false memories of the past. That is, in these cases, people retrieve a memory which is not part of the originally encoded information.

Besides the critical distinction between the stages of encoding, storing, and retrieving information, recent research has made a distinction between recollecting the past and believing that an event occurred in the past (e.g., Mazzoni & Kirsch, 2002; Scoboria, Mazzoni, Kirsch, & Relyea, 2004; Scoboria et al., 2014). A growing body of literature has demonstrated that people can have a strong belief that an event occurred in the past,

accompanied by only a weak recollection of the event (Mazzoni & Kirsch, 2002), or indeed that people can have a strong recollection of an event which is accompanied by a weak belief that the event occurred (Mazzoni, Scoboria & Harvey, 2010). This research highlights that what we often call ‘remembering’ is actually a combination of processes that includes recollection and belief.

The focus of this thesis is on the consequences of having a strong recollection accompanied by a weak belief. Previously, researchers have speculated that the same manipulation used to cause the attenuation of belief has also resulted in omission errors (Mazzoni, Clark & Nash, 2014). However, the experiments presented in this thesis are the first to examine whether a relationship exists between attenuated belief and omission errors. Specifically, in this thesis, we report four experiments examining whether undermining peoples’ beliefs about the past but not their recollections of the past, would result in omission errors.

The review of the literature to follow has three purposes. First, it will look at the ways our memories can become erroneous, with a specific focus on omission errors. Second, we then review the literature demonstrating that recollecting the past and beliefs about the past can co-occur or each independently occur when trying to remember events from our past. Finally, we outline the aims of this thesis.

## THE RECONSTRUCTIVE NATURE OF MEMORY

A commonly held belief is that memory operates like a video camera. A recent survey has shown that 63% of a lay sample endorsed the proposition that memory ‘works like a video camera’ (Simons & Chabris, 2011). This view of memory suggests that when we experience an event, a literal recording of the event is *stored* in our mind, and that to remember the event, we simply need to *retrieve* the relevant recording and mentally *replay* the event. However, decades of memory research has demonstrated that this idea of memory is flawed. Instead, research has shown that each time we recollect the past, we are, in fact, reconstructing the past. It is through this process of reconstructing our memories that our memory becomes susceptible to errors, such as reporting details incorrectly, reporting entirely new details or even omitting pieces of information.

One of the first demonstrations of this reconstructive character of memory was reported by Bartlett (1932). Bartlett used a method called repeated reproductions to reveal the reconstructive nature of remembering. Bartlett asked participants to read a story called ‘The War of the Ghosts’. Participants read the story twice and were then asked, at different time intervals, to recall the story. Initially, participants first recalled the story 15 minutes after reading it. Subsequently, participants were then asked to recall the story at different intervals, with some participants being asked to recall the story several years later. Bartlett was interested in how much of the story people were able to recall and how much of the recalled information had changed over the course of

time. The findings from Bartlett's research showed that participants often provided a shorter account of the story, recalling the gist (i.e., the general theme) of the story rather than reproducing the entire story verbatim (i.e., a word by word reproduction). Bartlett also found that participants reported what Bartlett termed 'transformations', replacing details such as 'canoes' from the original story into 'boats' in their recollection of the story. Perhaps the most interesting finding from this research was that participants either omitted information or provided explanations for elements of the story that were ambiguous to them (see Bergman & Roediger, 1999 for a replication). This research demonstrates that remembering the past is not a case of simply re-playing a video recording of the past in one's mind, but instead, remembering involves reconstruction of the past.

Bartlett's research of people mis-telling an innocent story is an example of how peoples' memory for the past can become erroneous. Whereas making an error while repeating a folk-tale is a benign memory error, researchers have demonstrated that errors, such as those described by Bartlett, can occur in situations where there are real consequences. The domain where these severe consequences frequently take centre-stage is the courtroom. One of those notable situations is in a situation where people witness a crime. Psychologists interested in false memories have used a variety of techniques to demonstrate that eyewitnesses can come to make memory errors when recalling details of a crime.

Over the past half a century, memory researchers have demonstrated that exposing people to erroneous and suggestive information can impact the accuracy (i.e., how accurate the memory report is) and completeness (i.e., how complete the memory report is) of their memory reports for past information (Loftus, 2005). In general, researchers have demonstrated three effects that such techniques can have on memory reports. The first is that people can report erroneous details about the past (e.g., reporting a stop sign which was actually a yield sign, Loftus, Miller, & Burns, 1978). Second, people can report entirely false events that they never actually experienced (e.g., remembering becoming lost in a shopping mall, Loftus & Pickrell, 1995). Finally, research has also shown that people can omit details from their memory reports (e.g., not mentioning the waitress who took the couple's order, Wright, Loftus, & Hall, 2001). Researchers have devised a number of paradigms to elicit these memory errors. Below we discuss these memory errors and the paradigms used to elicit them.

## CHANGING DETAILS WITHIN MEMORY

One of the most frequently used procedures used to demonstrate how memories can be changed is the misinformation paradigm (see Loftus, 2005 for a review). Experiments using the misinformation paradigm often start by exposing participants to a stimulus, such as a series of slides or a video of an armed robbery. Participants are then exposed

to misleading post-event information (e.g., a narrative containing misleading information). After encountering the misleading post-event, participants are then given a memory test. One of the first misinformation experiments was performed by Loftus et al. (1978; Expt. 1) who presented participants with a series of slides showing a car accident. One of the slides showed the car at a junction. In this slide, half of the participants saw the car at a junction with a stop sign, while the remaining participants saw the car at a junction with a yield sign (give-way sign). Participants then answered a series of questions which included one asking about the sign. Half of the participants saw a question with consistent information (e.g., asking about a stop sign when the participant had seen a stop sign), while the other half saw a question with misleading information (e.g., asking about a stop sign when the participant had originally seen a yield sign). The results showed that in a subsequent recognition memory test, participants who had been questioned with consistent information – the sign which was present in the original scene – 75% of participants recognised the correct sign. When questioned with misleading information (e.g., asking about a stop sign when the participant had originally seen a yield sign), only 41% of participants recognised the sign from the original slide. These results showed that presenting witnesses with misleading post-event information can result in the witnesses reporting details differently from what they originally saw.

Over almost four decades, research using the misinformation paradigm has demonstrated that details within people's memory reports can be changed when people encounter misleading post-event information. For example, participants have been misled about whether a victim had an arm or neck injury (Okado & Stark, 2005), about seeing bugs bunny at Disney World (Braun, Ellis & Loftus, 2002) and whether a thief was accompanied by an accomplice (Wright, Self & Justice 2000). These experiments demonstrate that misleading post-event information can contaminate people's memory reports about past experiences.

Another paradigm demonstrating how people can come to report erroneous details is the social contagion paradigm. Roediger, Meade, and Bergman (2001) paired each participant ( $N = 24$ ) with 'another participant' who was actually a confederate. Each pair saw six scenes of rooms from around a house (e.g., a bedroom, a kitchen, and a garage). Half the pairs saw the scenes for 15 seconds while the remaining half saw the scenes for 60 seconds. The participant and the confederate then took turns to recall items from each of the scenes (collaborative recall). During the collaborative recall, for half of the scenes, the confederate reported one highly consistent and one low consistent false item. That is, these items were not present in the original scenes. An example of a highly consistent item for the kitchen scene would be a toaster or a knife. A low consistency item for the kitchen would be oven mitts or napkins. Participants then completed an individual recall test where they had to recall as many items as they could for each of the scenes. The results showed that 22% of the false items reported by the confederate were reported by participants in the individual recall test, compared with only 6% of control items (high and low consistency items for the scenes not reported by the con-

federate). Participants were more likely to report the erroneous details when they had seen the original scenes for a shorter amount of time (15 seconds) compared with a longer amount of time (60 seconds). Also, participants made more errors by reporting high consistency items than low consistency items. The key finding from this experiment is that other people can influence the way we remember the past. However, it is also noteworthy that this effect was larger when participants were given less time to study the material and when the false item was highly consistent.

## IMPLANTING FALSE MEMORIES FOR EVENTS

The research reviewed above demonstrates that misleading post-event information can cause people to report erroneous details within their memory reports. However, research has shown that people can come to report that they remember entire events that they, in fact, did not experience, known as implanted false memories. One of the first experiments to demonstrate that people can come to report implanted false memories as 'remembered' events was conducted by Loftus and Pickrell (1995). In this experiment, information provided by the experimenter suggested that the participant had become lost in a shopping mall when aged between four and six years old. Before testing the participants, the researchers contacted the participants' parents to (a) collect details of three events the participant had experienced between the ages of four and six-years-old, (b) to find out details about the shopping centre where the participant might have visited around age five and who they might have been with, and crucially, (c) to ensure that the participant had not had a genuine experience of being lost in a shopping mall. Participants were then presented with narratives describing each of the four events, including the three genuine events (provided by the parents) and the false event of being lost in the shopping mall (including accurate details about the experience obtained from the parents). The narrative describing the participant being lost in the shopping mall included details about the participant getting lost and starting to cry before being helped by an elderly person and eventually being reunited with their family. Participants were asked to read each narrative and provide details about their memory for the event. Participants returned 1-2 weeks later for an interview where they were again asked to provide details about each of the four events. The interviewer used the information from the narratives to encourage the participant to provide information about each of the events. After the interview, participants were encouraged to think about the event before returning for an interview 1-2 weeks later. Recall that for each participant ( $N = 24$ ) there were three true memories. The results showed that 68% ( $n = 49$ ) of the true events were remembered, with participants providing more details about the event than had been provided in the narrative. This figure was consistent across all interviews. For the 24 false events, in interview 1, seven participants reported that they could remember details about the event, which decreased to six

participants (25%) in the second interview. This research showed that a small, but significant number of participants came to report remembering details of an event which had not occurred. The striking finding from this research is that participants came to remember this non-occurring event based simply on the small amount of information provided in the narrative.

Another way to elicit false memories is to present people with doctored evidence. In one experiment, participants were shown doctored photo evidence suggested that they had taken part in an event which they never actually experienced. Wade, Garry, Read, and Lindsay (2002) presented participants with doctored photographs showing the participant and some of their family members experiencing a hot-air balloon ride when aged between 4 and 8 years old. Participants were subsequently interviewed three times. In the first interview, participants were presented with four photographs. Three of these were genuine photographs and one was the doctored hot-air balloon photo. After presenting each photo, participants were asked to tell the researcher everything they could about the event. Next, participants rated how confident they were that the event in the photo had actually occurred (1 = 0% confident to 7 = 100% confident). Participants did this for each of the three true events and the false event. If participants were unable to remember the event in the photo, participants were given a little more time to think about the event and then the researcher used context reinstatement and guided imagery to aid their remembering of the event. In the second interview, participants were only asked about the events which they had not remembered in the first interview. Participants were asked whether they could now remember the event, and context reinstatement and mental imagery techniques were used. Interview 3 was identical to interview 1 in that participants were presented with each of the photos and asked to tell the researcher about the event, before rating their confidence that the event had occurred. The results showed that 10 (50%) of the participants, at the end of interview 3, had developed a false belief or memory for the hot-air balloon event. Participants were classified as having a clear false memory if their recalling of the event included elaboration of details not present in the photo. Participants were classified as having a partial false memory if their recalling of the event included elaboration of details of the false photograph (e.g., feelings, who was present) but did not indicate explicitly remembering the event. Confidence ratings for true events that participants had recalled was 90.8%, and 41.7% for non-recalled true events. For the false hot-air balloon event, participants who recalled the event provided confidence ratings of 44.5%, compared with 10% for participants who did not recall the event. This research shows that presenting people with misleading information in the form of doctored photographic evidence can result in people being easily misled into remembering an event which did not occur (see Nash, Wade, & Lindsay, 2009b for similar results using doctored video evidence).

Similar to the research reported above, using a variety of techniques, researchers have demonstrated that people can come to report remembering entire events which

never actually occurred. For example, participants have come to remember being attacked by a dog (Porter, Yuille, & Lehman, 1999) and spilling punch over the parents of the bride at a wedding (Hyman & Billing 1998). Such experiments raise interesting questions about the reliability of our memories for past events.

To summarise, research has shown that misleading post-event information can result in people reporting erroneous details of a past experience, or even entire events which did not occur can be injected into peoples' memories. These findings demonstrate how people can falsely remember the past which has consequences in settings such as the courtroom (e.g., false accusations). We now turn our attention to omission errors. Omission errors are details of a past experience that are not reported. While this is similar to forgetting, research has shown that using similar procedures as those described above to elicit changes and additions to memory can also increase the occurrence of omission errors.

## OMISSION ERRORS

The first experiment to specifically examine omission errors was conducted by Pezdek and Roe (1997). Pezdek and Roe asked four-year-old ( $n = 80$ ) and ten-year-old ( $n = 80$ ) children to view a series of slides with an experimenter. During the presentation of the slides, the experimenter either touched the children on the hand or shoulder for 15 seconds or did not touch them. After 15 minutes, participants were exposed to misleading post-event information presented in the form of a review of the earlier session. In this review, the researcher suggested that either the touch had not occurred (omission condition), the touch had been on the hand when in fact it was on the shoulder, or vice versa (change condition) or that there had been a touch when in fact there had not (addition condition). There were also two control conditions where children who either were touched or were not touched during the presentation of the slides were not exposed to any misleading post-event information during the review. The children were then asked to provide yes/no answers to a series of questions about the slide presentation, including one question about the touch. The results showed that participants in the change condition most frequently reported being touched in the suggested location more frequently than the original location compared with the control condition. However, participants in both the addition and omission conditions did not perform differently to their respective control conditions. This finding led Pezdek and Roe conclude that it was easier to change the contents of a memory than it was to induce omission errors or additions to memory reports. However, the results obtained in this research are limited given the small sample size for the number of conditions ( $n = 16$  per condition). Wright et al. (2001) argued that although the findings from Pezdek and Roe did not reach significant levels, the effect sizes indicate that for all conditions accuracy was impaired. Therefore, with a larger sample size, Pezdek and Roe might have obtained



enough power to detect an effect of misleading post-event information in all of the experimental conditions.

Building on the research reported by Pezdek and Roe (1997), there have been a number of experiments examining omission errors in children. Over three experiments, Roos af Hjelmsäter and colleagues found mixed results. The general methodology in these experiments was as follows. Children participants had a brief interaction with a stranger (actually a confederate of the experimenter). The children were then interviewed about this encounter with the stranger. In each of the experiments, the participants received socially administered misleading post-event information from either the stranger or someone else who claimed to have witnessed the child's interaction with the stranger. For example, Roos af Hjelmsäter, Granhag, Strömwall, and Memon (2008) recruited children aged 7 ( $n = 82$ ) and 12 ( $n = 92$ ) years old. During their encounter with the stranger, he asked the participant to help him choose a present for another child, a 5-year old boy. First, the stranger opened the rear passenger door, but there were no toys there. Then stranger then opened the driver's door and there were three toys. The participant was asked to help the stranger choose a toy to give as a gift and the encounter ended. There were two critical details. Half of the participants saw a suitcase when the stranger opened the rear passenger door, while the remaining half of the participants saw a passenger sitting in the front of the car. Prior to the interview, the participants had a brief conversation with the stranger. During this conversation, the stranger summarised the details of their original encounter and provided misleading post-event information. Half of the participants who had seen the suitcase on the back seat were told by the stranger that the back seat was empty ( $n = 44$ ). Half of the participants who had seen the passenger in the car were told that the stranger had been alone ( $n = 44$ ). For half of the participants who had not seen the suitcase, the stranger told them that his suitcase had been on the back seat ( $n = 43$ ). Finally, for half the participants who had seen not seen a passenger on the front seat, the stranger told the participant that his friend Eric was in the car ( $n = 43$ ). In the interview, the children were asked to provide a free recall account of the original encounter with the stranger. Next, participants were asked open-ended questions about specific parts of the event (e.g., what did the man look like). Finally, participants were asked specific questions, including one about any item on the back seat and one asking whether anyone else was with the stranger. In summary, participants saw either a suitcase or a passenger in the car. Half of the participants seeing either a passenger or the suitcase received misleading information from the stranger suggesting there was no suitcase or passenger. The remaining participants received misleading information that the passenger or suitcase was present. The results showed that both 7-year old and 12-year old participants did not differ on any of the measures. With regard to memory errors, participants in the commission condition made a significant more commission errors for the misleading information (59.52%) compared with the control item (3.45%). For participants in the omit condition, 31.40% of participants omitted the item compared with 29.27% omitting the control item, a

non-significant difference. When examining the centrality of the item manipulated, children in the experimental conditions made more errors for the peripheral detail (suitcase) 61.45% compared with the central detail (passenger; 29.89%). The results of this research showed that omission errors occurred less frequently than commission errors.

In a similar experiment, Roos af Hjelmsäter, Granhag, and Strömwall (2009) found that additions to memory and omission errors occurred at a similar rate. Participants ( $n = 176$ ) were children aged 11- and 12-years old. In this experiment, when the children encountered the stranger, he was either accompanied by a passenger or alone. Immediately prior to the interview, two weeks after the encounter with the stranger, participants received misleading information by watching a video interview of a person who claimed to have witnessed the participant's interaction with the stranger. The witness in the interview was either a 10-year old girl or a woman. Half of the participants saw the woman while the other half saw the child witness. For participants in the commission condition, the witness mentioned seeing a passenger, although the participant had not seen a passenger. For participants in the omit condition, the witness stated that the stranger had been alone whereas there had actually been a passenger in the car. In the control condition, no misleading information was provided. As in the previous experiment, participants were interviewed initially using a free recall test, then open questions and finally specific questions including one about the presence of a passenger. The results showed that participants who had received misleading information were 83.50% less likely to correctly report the presence or absence of a passenger. There was also not a significant effect of misleading post-event information on commission or omission errors, suggesting that the misleading information had a similar effect on both errors of commission and errors of omission. These findings demonstrated that misleading information from a video of a witness had a similar influence on the frequency of both omission errors and commission errors.

Finally, Roos af Hjelmsäter, Granhag, and Strömwall (2012) found omission occurred more frequently than additions to memory. Participants ( $N = 115$ ) were children aged 10-13- years old. The procedure was as described in the two previous experiments. However, half of the participants (omit condition) saw five additional items compared with the other half of the participants (commission condition). These items were a suitcase on the back seat, a female passenger in the front, the stranger was wearing a hat, the stranger talked on the phone briefly and the stranger shook the child's hand at the end of the interaction. As in the previous experiments, the interview took place two weeks after the participant had encountered the stranger. Half of the participants were interviewed with a confederate who was an adult claiming to have witnessed the participant's encounter with the stranger. In the omit condition, the confederate denied seeing the five target items, while in the commission condition the confederate claimed to have seen the five target items. The results showed that participants in the omit condition omitted two items more often than participants who had been interviewed

alone. The items were for the handshake and the phone call. All other items were not significant. Similarly in the commission condition, participants exposed to the influence performed similarly to participants in the control condition. These findings demonstrated that omission errors occurred more frequently than commission errors.

Otgaar, Candel, Smeets, and Merckelbach (2010) found that younger and older children were equally susceptible to making omission errors, whereas younger children were more likely to add details to memory than older children. Participants were children aged 4 ( $n = 59$ ) and 10 ( $n = 59$ ) years old who were instructed to remove a hat, a skirt and the shoes from a puppet. Immediately after, the children went into another room and were asked by the researcher to describe what they had done earlier in the experiment (i.e., which items they had removed). Participants in the omission condition were told that they had not removed one of the items of clothing (e.g., the skirt). Participants in the addition condition were told that they had removed another item (e.g., a jacket). Immediately after receiving this misleading information, the participant was taken back to see the puppet who was either wearing the omitted item or was not wearing the added item. Participants were immediately interviewed about which items they had removed. Participants were again interviewed one-week later. Finally, participants were also asked by their parents to name the items of clothing that they had removed from the puppet. Before receiving the misleading information, 95% ( $n = 112$ ) of participants correctly reported the three items of clothing which they had actually removed from the puppet. Analyses were only conducted on participants who had reported removing the two other items (omission condition) or the three items (addition condition). Only 80 parents completed the interview conducted with the parents. The result showed that children in the omission condition were more likely to omit the item suggested by the researcher than participants in a control condition. Across the three interviews, the rate of omission errors decreased. At interview 1, 45% ( $n = 27$ ) of the children omitted the item which decreased to 20% ( $n = 12$ ) at interview 2 and 13% ( $n = 6$ ) at interview 3. Commission errors also decreased across the interviews. At interview 1, 66% ( $n = 38$ ) of the children reported the erroneous items, compared with 55% ( $n = 29$ ) at interview 2 and 42% ( $n = 14$ ) at interview 3. When examining age-related differences, the authors found no age difference for omission errors. However, for commission errors, younger children were twice as likely to report the erroneous item at interview 1. Younger adults also made more errors than older children at interviews 2 and 3. The findings of this experiment showed that both younger and older children were equally likely to make an omission error, whereas commission errors were more common for younger than older children. This research also suggests that omission errors are not stable over time and decrease over longer periods of time.

In summary, researchers examining omission errors in children have found mixed findings. These mixed findings could perhaps be attributed to the mixed methodologies used in these experiments. For example, in each of the three experiments by Roos af Hjelmsäter and colleagues (reported above) there were varying sources of misinfor-

mation as well as differences in the target items manipulated. In the current research, we were interested in omission errors in adults. While there have been fewer experiments conducted using adult participants, the findings are also more consistent, showing that adults are susceptible to errors of omission following the use of misleading and suggestive techniques.

One example of omission errors in adults was reported by Wright et al. (2001; Expt. 1). Participants ( $N = 115$ ) attended a first session where they were instructed to copy a series of 12 drawings depicting a man and a woman going on a date. These drawings showed, for example, the man wearing a suit, the woman wearing a dress, the man knocking on the woman's door with a bunch of flowers, the man and woman entering a restaurant, and so on. One week later, participants were re-presented with what they were told was someone else's copy of the drawings. In this version of the drawings, participants were either presented with a new drawing (e.g., a new picture showing the waitress taking the couples order) which was not present in the original drawings (add condition), or one of the drawings they had originally seen was omitted (omit condition). There were also two control conditions where participants were not re-presented with the drawings. Participants in all conditions then completed two memory tests. In the first test, participants were asked to recall all of the original drawings, and the second test was a recognition test. The results showed that 56% of participants in the omit condition omitted the drawing which had not been re-presented in the second phase of the experiment, (cf. 33% in the control condition). Also, 34% of participants in the omit condition did not recognise the drawing which had not been re-presented in the second phase (cf. 16% in the control condition). In the add condition, 20% of participants recalled the new drawing, (cf. 6%, in the control condition) and 46% recognised the additional drawing (cf. 36% in the control condition). This research demonstrated that people make omission errors at a similar rate to commission errors. Furthermore, this research shows that omission errors can occur not only in recall memory tests but also in recognition memory tests.

Omission errors have also been found to occur using the social contagion paradigm reported by Roediger et al. (2001). Merckelbach, Van Roermund, and Candel (2007) showed participants, together with a confederate, six scenes from around a house (e.g., a bedroom, a garage, a kitchen). After a brief filler task, both the participant and confederate engaged in a collaborative recall task. For each scene, the participant and confederate took turns to recall individual items from the scene until they had each recalled six items for that scene. This was done for each of the six scenes. In the add condition ( $n = 30$ ), for two of the scenes, the confederate reported an item that had not been present in the original scene. In the omit condition, for two of the scenes, the confederate denied seeing one of the items reported by the participant by saying "the detail that you mention was certainly not present in this picture; otherwise I would have noticed that". In the control condition, the confederate did not deny seeing any items or report any additional items. Participants' memory for the scenes was tested in the

form of a recall task completed individually. The results showed that in the add condition, 52% ( $n = 16$ ) of participants reported at least one of the additional item reported by the confederate, compared with 0% in the control condition. In the omit condition, 72% ( $n = 21$ ) of participants omitted at least one of the items denied by the confederate compared with 33% ( $n = 10$ ) in the control condition. These results showed that a specific social challenge to a participant's memory can result in omission errors occurring at a similar rate to additions to memory.

### INTERIM SUMMARY

In the literature explored above, it is clear that human memory is prone to errors, resulting in people reporting different details to which they originally saw, report experiencing entire events which never occurred or even failing to report previously encountered information. Since the focus of this thesis is on omission errors, below we explore some of the explanations proposed to account for the occurrence of omission errors.

### WHY DO OMISSION ERRORS OCCUR?

At least three explanations for how omission errors occur have been postulated. These explanations differ in important ways. For example, some researchers have speculated that omission errors could occur as a result of the original detail becoming *erased* from memory following the presentation of conflicting post-even information (Merckelbach et al., 2007; Pezdek & Roe, 1997). Others have proposed that omission errors occur as a result of social influence (e.g., Merckelbach et al., 2007). Another explanation, proposed by Wright and colleagues is that omission errors occur as a result of inhibition. Each of these explanations is examined further below.

The term 'memory erasure' has been used by both Pezdek and Roe (1997) and Merckelbach et al. (2007) to describe omission errors. An early account for misinformation effects was that the new information overwrites the original information (Loftus et al., 1978). More recent accounts posit that both traces co-exist in memory and that it is the stronger of the traces which is volunteered as a memory (see Ayers & Reder, 1998 for a review). Other researchers have argued that using the term '*erasure*' in relation to memory errors should be used cautiously since it is impossible to demonstrate that information has actually been erased from memory (Wright et al., 2001). Otgaar, Meijer, Giesbrecht, Smeets, Candel, and Merckelbach, (2010) demonstrated that, in children, omission errors might not occur as a result of memory erasure. Otgaar and colleagues asked 75 children, aged around seven years old, to remove three items of clothing from a puppet. Participants were then taken into another room and asked to tell the researcher the name of the three items of clothing they had removed from the puppet.

Participants then received misleading information from the experimenter who told the participant that they had not removed one of the three items they had claimed to have removed. Participants were then taken back into the room and shown the puppet which was wearing the item of clothing that the researcher had told the participant they had not removed. Participants were then interviewed about which items of clothing they had removed both immediately after and one week later. The results showed that after the second interview, 32% ( $n = 24$ ) of the participants failed to mention that they had removed the item of clothing of which the experimenter had provided misleading information. These children were then given a choice reaction time task whereby they were presented with an image of a piece of clothing and had to indicate whether they had removed the item or not. Participants were asked to be both quick and accurate in the choice reaction time task. The results showed that the children often selected the item of clothing which the researcher had told them they had not removed as an item they had removed. This finding suggests that participants were able to remember which items of clothing they had removed from the puppet, and that the omission errors observed in this experiment are more likely to be explained by social factors such as memory conformity. The results of this research are the only available evidence suggesting that omission errors are not caused by memory erasure.

Wright et al. (2001) explained their results in relation to retrieval-induced forgetting (e.g., Anderson, Bjork & Bjork, 1994). Retrieval-induced forgetting occurs when participants are asked to recall only part of a to-be-remembered stimuli. For example, Anderson et al. (Expt. 1) demonstrated retrieval-induced forgetting by having participants recall some items from a category of previously studied words (e.g., FRUITS: orange, banana, lemon). In a subsequent category-cued recall test, participants recalled fewer of the items which had not been practised from the practised category. Retrieval-induced forgetting effects are explained in terms of retrieval inhibition. When some items of a category are practised, there is also competition from the related but non-practised items from within the category. To reduce the risk of erroneously reporting the non-practised items during the retrieval practice, inhibitory control processes inhibit the non-practised items, making them harder to recall in a subsequent memory test. In Wright and colleagues' experiment, participants in the omit condition would have to inhibit interference from the omitted drawing during the second phase of the experiment, making this item more difficult to recall and recognise in the subsequent memory tests.

Omission errors have also been explained as a function of social influence. Here, the argument is that people make omission errors because the rememberer is affected by other people. In a classical experiment, Asch (1955) demonstrated how peoples' decisions can be influenced by other people. Individual participants ( $n = 123$ ) took part in the experiment alongside a group of six to eight confederates. Participants saw a single line on a card, and then a second card showing three lines of varying sizes. Their task was to identify the line from the first card, on the second. In total, there were 18 trials

and on 12 of these trials, all of the confederates intentionally identified an incorrect line on the second card. Asch reports that on average, participants had been found to make erroneous matches in 1% of trials without influence from other people. Asch was interested in whether participants would be influenced by the majority decision of the confederates even when the confederates were choosing incorrect responses. The results showed that participants yielded to the erroneous majority decision on 36.8% of trials. However, there were also striking individual differences between participants' susceptibility to the social influence. Around 25% of participants did not conform to the majority decision and instead reported the correct answer on all trials. Likewise, some participants yielded to the majority decision on all of the trials. This research demonstrates the significant influence other people have on our responses.

Researchers have identified two forms of social influence; informational and normative social influence (Deutsch & Gerard, 1955). Informational social influence occurs when people are motivated to be accurate and they report or omit information which they believe someone else is accurate about. Thus, informational social influence results in omission errors because people believe that the other person/people are correct while they are incorrect. Normative social influence occurs when people conform to the 'group opinion' to be in agreement with other members of a group. That is, their internal belief is correct, but they report an incorrect response to conform to the group. In relation to omission errors, people could omit information because they want to be in agreement with other people. The effect social influence can have on memory was demonstrated by Gabbert, Memon, and Wright (2006, Expt. 2) who asked pairs of participants to individually watch a mock crime video. While the sequence of events in each of the videos was the same, each participant saw different details within the video. For example, in the addition/omission condition, one participant saw the thief steal £20, while the other participant did not see the thief steal anything. In the change condition, one participant saw the thief steal £20 while the other participant saw the thief steal a credit card. These participants were then allowed to discuss the events of the video for ten minutes. Because each participant had witnessed different details, there were some disagreements between the participants. This allowed for the possibility that participants would report new items, report different items or even omit items based on the disagreement with the other participant. The results showed that participants were most influenced when encountering new items (45% influenced), followed by different items (29%) and then by seen but omitted items (10%).

To summarise, three explanations for the occurrence of omission errors have been proposed. Omission errors occurring as a result of memory erasure is difficult to find evidence for (Wright et al., 2001), but evidence suggesting that omission errors are not caused by erasure is compelling (Otgaar et al., 2010). Therefore, two opposing explanations remain; retrieval-induced forgetting and social contagion/social influence. In the research described in the current thesis, we propose an alternative explanation for how omission errors occur. Researchers have speculated that omission errors could be

caused by the elicitation of nonbelieved memories (Mazzoni, Clark & Nash, 2014; Otgaar, Scoboria & Mazzoni, 2014). Nonbelieved memories (Mazzoni et al., 2010; see also Scoboria, Nash & Mazzoni, in press) are memories for which people have a stronger recollection of the event than their belief that the event occurred. We argue that omission errors could occur as a result of people attenuating their belief for the omitted items. That is, when participants receive misleading post-event information suggesting that an event did not occur, termed negative misinformation (Mazzoni et al., 2014), it is their belief about the occurrence of the event which is attenuated while they maintain strong recollections for the omitted item. Research has shown that belief is more influential than recollection on peoples' attitudes and intentions (Bernstein, Scoboria, & Arnold, 2015).

## DISSOCIATION BETWEEN RECOLLECTION AND BELIEF

It has been noted that most memory research has focused on believed memories (Scoboria et al., 2014). That is, the events remembered are both recollected and believed to have occurred. Brewer (1996) claimed that recollective memories are, "accompanied by a belief that the remembered episode was personally experienced by the individual in that individual's past" (p. 61). This view of remembering suggests that both belief and recollection are present when remembering the past. Here, we review the emerging literature which has demonstrated that recollecting an event and believing that an event occurred are distinct processes involved in remembering the past.

Mazzoni and Kirsch (2002) were among the first to suggest that past events could be believed to have occurred even in the absence of a recollection of the event. In their model, Mazzoni and Kirsch argue that a question, such as 'what were you doing last Tuesday?' prompts a memory search. The rememberer must then search their memory for details of their activities from last Tuesday. The memory retrieved is then assessed for its 'goodness of memory', i.e., how vivid it is. The goodness of the memory is then compared with a memory criterion. The memory criterion is a pre-set internal level at which the memory will be accepted as such (i.e. is it vivid enough to be a memory?). If the goodness of memory meets the criterion, the event is considered to be remembered.

However, when the goodness of memory is not sufficient to meet the memory criteria, Mazzoni and Kirsch (2002) propose that people can still conclude that an event occurred if they have enough information available which allows them to believe that the event occurred. For example, you might not have a specific memory for last Tuesday, but you might know that you have been at work each weekday for the last three weeks, which means on Tuesday you must have been at work. You might also know that each Tuesday evening you go to the gym, and while you cannot recollect specifically going to the gym last Tuesday, you know you have not missed a gym session for many



weeks. Thus, using this information, you can conclude that on Tuesday you were at work, and then you went to the gym. However, knowing what you did on Tuesday is not based on a specific recollection for Tuesday's events. Instead, it is based on the knowledge that you have about your recent activities, you have enough information to believe that this is what happened on Tuesday.

To summarise, Mazzoni and Kirsch (2002) argue that when faced with remembering the past, retrieving a strong memory is enough to conclude that the event occurred. However, the absence of a strong memory is not necessarily diagnostic that the event did not occur. Instead, they propose that people can believe that the event occurred if there is sufficient information available.

Empirical support for Mazzoni and Kirsch's (2002) model was provided by Scoboria et al. (2004). In this experiment 684 undergraduate student participants rated ten autobiographical events (e.g., Getting lost in a shopping mall) for general and personal plausibility (i.e., the event could happen to someone, the event could happen to me), belief and memory. The results showed that participants rated, on average, general plausibility ( $M = 4.63$ ,  $SD = 1.64$ ) higher than personal plausibility ( $M = 3.77$ ,  $SD = 1.86$ ). Personal plausibility was also rated higher than belief ( $M = 3.19$ ,  $SD = 1.80$ ). Finally, belief ratings also exceeded memory ratings ( $M = 2.34$ ,  $SD = 2.00$ ). These data suggests that for an event to be remembered, it must be believed to have occurred, and for it to be believed, it must be considered personally plausible and generally plausible. Interestingly, for 50.3% of events rated, belief and memory ratings were equal. In 45.4% of cases, the belief ratings were higher than memory ratings, while in 4.3% of cases belief ratings were lower than memory ratings. Overall, the nested relationship between belief and memory was found for 95.7% of events rated suggesting that most memories are believed to have occurred more strongly than they are recollected.

In summary, while research once confounded recollection with belief, research has clearly shown that recollection and belief both contribute to the process of remembering the past. Subsequent research has refined this distinction further, making a distinction between different types of belief.

## BELIEVING AND RECOLLECTING EVENTS

Recollection has been defined as "conscious awareness of remembering, re-experiencing of perceptual details of the event, recognising the spatial and temporal characteristics of the event, and novel appraisal of the event as it influences current emotion" (Scoboria, Talarico & Pascal, 2015, p. 338). This view of recollection is shared by other theories of remembering. For example, Brewer (1996) describes recollective memory as a memory for a specific episode which is experienced as a reliving of the episode. Rubin (2006) describes reliving an episode as a defining feature of episodic

memory. Thus, the term recollection appears to be consistently reported as the ability to relive or re-perceive the past.

Besides recollecting events, it is also possible for people to believe that an event occurred. For example, we can believe that we were born (Mazzoni & Kirsch, 2002). While it is unlikely that we can recollect our birth, we have enough information available (i.e., being alive today) for us to conclude that our birth must have occurred. The term belief has been used in a number of theories of remembering. For example, Rubin (2006) uses the term belief as “the belief that a memory is accurate” (p. 294), while Scoboria et al. (2014) use the term belief as “the truth value attributed to the occurrence of an event” (p. 1243). Scoboria and colleagues (Scoboria et al., 2015; Scoboria & Pascal, 2016) have demonstrated both forms of belief discussed by Rubin (2006) and Scoboria et al. (2014) are accurate and reflect two distinct forms of belief. Scoboria et al. (2015) argue that Rubin’s use of belief is *belief in accuracy*, and is an assessment that recollected details are believed to be accurate. However, the belief discussed by Scoboria et al. (2014) is *belief in occurrence* and is different to belief in accuracy in that it is an appraisal of the entire event.

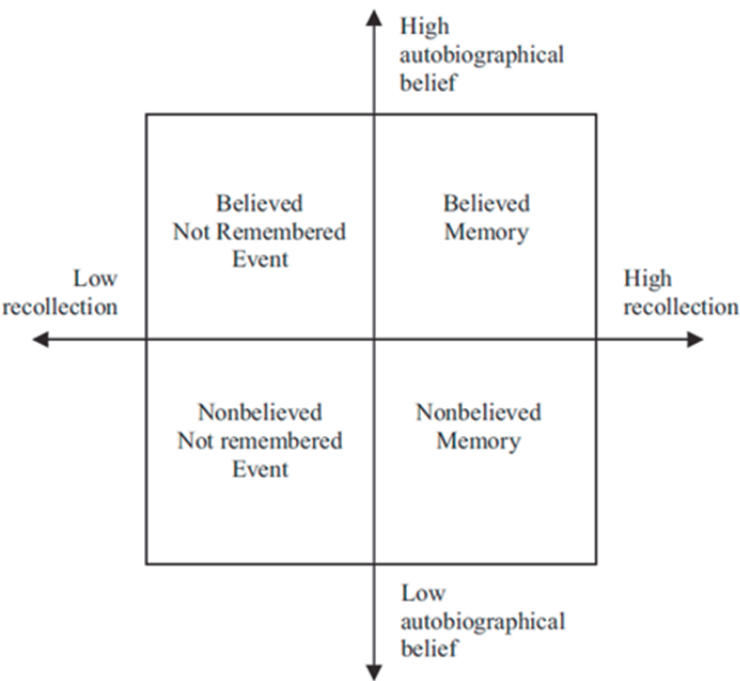
The distinction between belief in accuracy and belief in occurrence is described best by Scoboria et al. (2014) using the lyrics from Lerner and Lowe’s (1958) song “I remember it well”. In the lyrics, Honoré is recalling a previous encounter between himself and Marnita. The lyrics are: “We met at nine. *We met at eight*. I was on time. *No, you were late*. Ah yes, I remember it well. We dined with friends. *We dined alone*. A tenor sang. *A baritone*. . .” In this example, it is not Honoré’s belief in the occurrence of the event that is being challenged, but his belief in the accuracy of specific details about the recollected event. Thus, belief in accuracy is a truth value relating to the accuracy of a specific item or piece of information, whereas belief in occurrence is a truth value relating to the occurrence of an entire event/episode. However, Blank (In press) argues that making such a distinction might not be so easy.

The distinction between recollection and belief has been likened to the distinction between remembering and knowing (Tulving, 1985). There is a clear relationship between ‘recollection’ and ‘remembering’. However, we agree with Scoboria and Pascal (2016) that ‘belief’ and ‘knowing’ are not the same. One of the key differences between remember/know judgements and judgements of belief and recollection is that remember/know are either/or choice. For example, participants are asked to recall or recognise an item and then decided whether they remember the item, or just know the item is ‘old’. In experiments which have employed belief and recollection, both are measured. That is, participants rate both their appraisal of the strength of the recollection and the strength of their belief. Tulving (1985) does state that when remembering the past, people could be remembering, knowing or “a mixture of the two” (p. 6), however, in research, this is not how these measures have been applied. So while there may be some similarities between the measures of remember/know and recollection/belief, the approach to measuring each construct is very different.

It also could be that many instances of knowing could result in believing. That is, if you know a number of details about a given date in the past, you could from this knowing come to believe that a certain event occurred on that date. For example in the earlier example of remembering what you were doing last Tuesday, you might *know* a number of facts (e.g., I work weekdays, I haven't had a weekday off in three weeks, I know I go to the gym on Tuesdays). Thus, knowing could be considered a contributor to belief.

To summarise, research has demonstrated that recollection and belief are distinct components of remembering, with recollection reflecting the ability to mentally re-live or re-perceive the event, and belief referring to the truth value of the events occurrence. However, belief can be divided further into the belief that an event occurred and the belief that a detail is remembered accurately.

Making a distinction between recollection and belief allows for the past to be represented by varying degrees of both belief and recollection. Scoboria et al. (2014) argue that belief and recollection are continuous variables. Figure 1 shows four possible event representations which can occur given differing strengths of both belief and recollection. Using Figure 1, below we explore three of the event representations including the evidence available to support the existence of each.



**Figure 1.** Event representations based on belief and recollection strength (Scoboria et al., 2014).

### *Believed Memories*

In the top right corner of Figure 1, where both belief and recollection are high, believed memories are proposed. As previously mentioned, much of the research conducted on memory has focused on events which are both recollected and believed to have occurred. Theories of remembering, such as that proposed by Brewer (1996) have suggested that remembering includes both the ability to re-perceive an event, accompanied with a belief that the re-perceived event is a genuine. This view suggests that both belief and memory are strongly associated. While few experiments have mentioned specifically that their research examined believed memories, researchers (e.g., Scoboria et al., 2014) have argued that believed memories are the most commonly studied type of memory.

One experiment found that when participants were asked to provide a memory of the past, the most common type of event reported was a believed memory. Scoboria and Talarico (2013, Expt. 1) asked 171 participants to recall five autobiographical events from when they were six years old or younger. For each of the events, participants provided a brief three or four-word description of the event. Participants were then presented with these brief descriptions and asked to rate the strength of their belief that the event had occurred, the strength of their recollection of the event, how plausible the event was and finally 15 memory characteristics (e.g., how vivid the memory was). The results showed that most of the recollections ( $N = 855$ ) were believed memories (58.6%,  $n = 501$ ). Interestingly, 38.3% ( $n = 328$ ) of the recollections were classified as believed-not-remembered events. Nonbelieved memories were least frequently reported (3.0%,  $n = 26$ ). These results showed that when people are asked to freely report recollections of the past, most recollections are believed to have occurred, with only a few recollections being nonbelieved memories.

### *Believed, Not Remembered Events*

Believed, not remembered events (see Figure 1, top-left corner) are events people believe to have occurred, but for which they have little or no recollection of. That is, for these events, belief strength is high, and recollection strength is lower than that of belief. Having a belief in the absence of a recollection was suggested as an event representation in the theoretical model proposed by Mazzoni and Kirsch (2002). Mazzoni and Kirsch argued that in the absence of a specific recollection of an event, people can still believe that the event occurred if there is sufficient information available.

Research has shown that it is possible to increase a peoples' belief that an event occurred without them developing a specific memory. Mazzoni, Loftus and Kirsch (2001) asked 57 Italian participants rate 40 events for plausibility (1 = highly implausible, 8 = highly plausible) and 36 events for likelihood (1 = certain the event had not happened to them, 8 = certain that the event had happened to them). One of the events rated was

the target event, witnessing a demonic possession. Three months later, participants were asked to read 12 mini-articles on various topics, including three about witnessing a demonic possession. The mini-articles provided information such as how common it is to witness a demonic possession and what happens when someone is possessed by a demon. For some participants, these mini-articles referred specifically to Italian culture (own-culture), whereas for other participants the mini-articles talked about other cultures (other-culture). Participants in a control condition did not read any mini-articles on witnessing a demonic possession. After a one-week delay, participants returned and again rated the plausibility and likelihood that the same 40 events had occurred. The results showed that reading the mini-articles referring to both own-culture and other-culture possessions resulted in increased plausibility and likelihood ratings for the target event compared with the control condition. Specifically, mean event plausibility ratings increased from 0.11 to 2.37 for participants in the own-culture condition, and 0.30 to 1.90 in the other-culture condition. In the control condition, plausibility increased from 0.61 to 1.06. For likelihood ratings, participants in the own-culture condition increased from 1.21 to 2.05, while likelihood ratings provided by participants in the other-culture condition changed from 1.15 to 1.30. In the control condition, likelihood ratings changed from 1.39 to 1.33. These results demonstrate that providing participants with information about an event, suggesting it is plausible to have experienced the event, can increase participant's ratings about whether they experienced the event. The likelihood questionnaire used in this research has been associated with belief (Mazzoni & Kirsch, 2002) and uses the same style of question as used for belief in the Autobiographical Belief and Memory Questionnaire (Scoboria et al., 2004). These findings suggest that it is possible to increase people's belief that an event occurred when people are provided with information which suggests the event could plausibly have occurred.

Coming to believe that an event occurred, but not necessarily recollecting the event has also been associated with other phenomena. Believed memories could explain false confessions. For instance, research has shown the internalised beliefs can result in confessions, without the confessor actually remembering the event (Kassin & Kiechel, 1996; Nash & Wade, 2009). That is, innocent suspects who falsely confess do not come to recollect committing the crime, but simply believe that they could have committed the crime.

### *Nonbelieved Memories.*

In this section, we review the literature on nonbelieved memories. This thesis is focused on the consequences of having a nonbelieved memory, and therefore we provide a more extensive review of this literature. We begin by reviewing the literature that prompted researchers to begin examining nonbelieved memories before moving to the experimental work which sought to elicit such memories in the laboratory. More recent research has examined nonbelieved memories across the adult lifespan and examined

the reasons people report for developing a nonbelieved memory. Nonbelieved memories (see bottom right of Fig. 1) are event representations characterised by high recollection and low belief. Nonbelieved memories were first identified by Scoboria et al. (2004) who found that for 95.7% of events rated, the nested model held true. That is, for these events, belief ratings were higher than recollection ratings. However, for a small number of events (4.3%) participants rated their belief that the event occurred lower than their recollection for the event. These findings suggested that people are able to recollect events even when their belief that the event occurred is lower than recollection strength.

There is anecdotal evidence to support the idea that people can have stronger recollections than beliefs about their personal past. A famous example of a nonbelieved memory was reported by the developmental psychologists Jean Piaget. Piaget (1951) recalled a memory from around the age of two years old in which he was the victim of an attempted kidnapping. While his nurse pushed him in his pram, a man approached and attempted to take Piaget. His nurse prevented the kidnapping. However, when Piaget was about 15-years old, he learned that this event had not occurred and that his nurse had made up the story. He, therefore, assumed that he must have learnt about this event from his parents. However, despite learning that this event had not occurred, he stated that he could still vividly recollect details such as scratches on his nurse's face, details of the police officer who arrived on the scene, and a gathering crowd. Specifically, Piaget stated "I can see, most clearly, the following scene, in which I *believed* until I was about fifteen" (p. 188). Piaget's account is a striking example of how people can continue to recollect events once believed to have occurred, but for which the rememberer has now attenuated their belief.

In an attempt to understand nonbelieved memories further, Mazzoni et al. (2010) asked 207 British and 1386 Canadian undergraduate students whether they had a memory of an event which they no longer believed to have occurred. Around 22% ( $n = 349$ ) of the sample reported having such a memory. A subset of those participants claiming to have a nonbelieved ( $n = 58$ ) memory were asked to provide additional details about their memory. These participants were asked to provide details of a believed memory and a believed but not remembered event. These three recollections were then rated for phenomenological characteristics examining recollective qualities, the ability to relive or mentally travel back in time, perceptual qualities, spatial characteristics and emotional valence and intensity triggered by the recollection. Self-reported details of why people had come to stop believing the event to have occurred were also collected. The results reveal three main reasons for why people come to stop believing in their memories. The most commonly reported reason for people having a nonbelieved memory was social feedback (56%). That is, for these participants, someone told them that the event never happened, or that it happened differently to the way it was remembered. The second reason was event implausibility (36% of participants). These participants attenuated their belief because the event they recollected was now con-

sidered implausible. The third reason people attenuated their belief was because of contradictory evidence (7% of participants). These participants had either found evidence refuting their memory, or had been unable to find evidence to support their memory. For the memory characteristics, the researchers found that nonbelieved memories continue to have the same phenomenological characteristics as memories for which people believed to have occurred. There are several interesting findings in this research. The first is that nonbelieved memories were found more commonly than might be expected from previous research (e.g., Scoboria et al., 2004). Also, nonbelieved memories appear to occur when believed memories are challenged in some way (e.g., social feedback, plausibility). Finally, nonbelieved memories are similar to memories which are still believed to have occurred.

It is worth noting at this point that when Mazzoni et al. (2010) introduced the term nonbelieved memories, it was unclear whether people had actually stopped believing that the event had occurred altogether or whether they had attenuated their belief below the strength of recollection. Subsequent research has shown that when nonbelieved memories are elicited in the laboratory, belief is rarely completely withdrawn. Instead, researchers have found that people attenuate their belief to the point that it is significantly lower than recollection ratings. Recent research has identified three subtypes of nonbelieved memories, based on varying belief and recollection strengths. Scoboria et al. (in press), using cluster analysis, found three distinct patterns of nonbelieved memories; classic, weak and grain of doubt. Classic nonbelieved memories are characterised by high recollection ratings and low belief ratings. Weak nonbelieved memories are characterised by belief and recollection ratings which are below the scale midpoint, with belief being significantly lower than recollection. Grain of doubt nonbelieved memories are characterised by recollection ratings which are high, but belief ratings are also high (above the scale midpoint). While each of these types of nonbelieved memories have different characteristics, in all cases, belief ratings were significantly lower than recollection ratings. Interestingly, Scoboria and colleagues also examined whether different reasons for attenuating belief resulted in different sub-types of nonbelieved memories. The results showed that both classic and weak nonbelieved memories were most commonly associated with events which had been considered implausible or where the rememberer had received social feedback from someone else telling them that the recollected event had not occurred. Classic nonbelieved memories also occurred when people were unable to obtain evidence to support the occurrence of an event. Finally, weak nonbelieved memories were often found when people found the memory to be inconsistent with their view of another person. These findings showed that there are different sub-types of nonbelieved memories and that continued research is needed to examine the factors which influence belief and how different factors could influence belief in different ways.

In Chapter 2 of this thesis, we report research which has demonstrated that nonbelieved memories can be elicited in the laboratory. Specifically, we investigated

whether social feedback during a debriefing session might lead to changes in belief and foster the production of nonbelieved memories (see below). Researchers have also elicited nonbelieved memories for childhood memories in both adults and children. Using a false memory implantation procedure, Otgaar, Scoboria, and Smeets (2013) experimentally evoked nonbelieved memories for a false childhood event in both 10-year old children and adults. After implanting a false memory for a hot-air balloon ride using suggestive interview techniques, participants were debriefed and told that the event was fabricated. In 40% of cases (adults:  $n = 12$ ; children:  $n = 29$ ), participants indicated that they remembered the false event but now did not believe it had occurred, and this pattern remained stable at a one-month follow-up. Thus, nonbelieved memories can be experimentally induced for recent events as well as for false memories from childhood and can endure over time.

Mazzoni et al. (2014) examined whether true memories could also be challenged, resulting in nonbelieved memories. Using the same procedure as Clark et al. (2012), instead of 'debriefing' participants about false memories, Mazzoni and colleagues told participants that they had not performed actions which they had in fact performed. Again the results revealed that this manipulation had a greater effect on belief than on memory and that the resulting nonbelieved memories shared many of the phenomenological characteristics of believed memories (see also Otgaar, Scoboria, Howe, Moldoveanu, & Smeets, 2016).

Previous research on nonbelieved memories has examined this phenomenon in undergraduate populations, often with participants aged around 18 - 20 years old (e.g., Clark et al., 2012; Mazzoni et al., 2014; Otgaar et al., 2013). Scoboria, Memon, Gawryłowicz and Clark (2015) examined nonbelieved memories across the adult lifespan. To collect a sample of adults ageing from 18 – 72 years old, Scoboria and colleagues posted a survey on Amazons Mechanical Turk asking people whether they had a nonbelieved memory. In total, they received 786 valid responses. Participants from this sample of 786 respondents were then invited to take part in the main experiment. Participants were recruited using age ranges. Participants aged 18-29 ( $n = 22$ ), 30-39 ( $n = 25$ ), 40-49 ( $n = 32$ ), 50-59 ( $n = 37$ ) and 60-72 ( $n = 22$ ) took part in the main experiment. The procedure for the main experiment was a replication of Mazzoni et al. (2010) in that participants were asked to describe their nonbelieved memory, provide belief and recollection strength ratings, and also rate phenomenological characteristics (e.g., how clear are the visual details of the memory?). Participants provided the same ratings also for a believed-not-remembered event and a believed memory from when they were the same age as the event for the nonbelieved memory. The results showed that nonbelieved memories were reported for events that had occurred a different ages. However, the vast majority were for events occurring at ages 4 – 12. The age at which these memories became nonbelieved was around the age of 23 years old. The results from Scoboria et al. (2015) suggest that childhood memories are subject to re-appraisal later in life, especially in the period of early adulthood. However, there was also an interest-



ing sub-group of older adults aged 60 years who had a nonbelieved memory for an event that had occurred around the age of 56 which had become a nonbelieved memory on average around the age of 59. Therefore, while 23 years old appears to be an important time for appraising and revising our memories, revision of memories in later life can still occur (see Brédart & Bouffier, 2016 for a replications of Scoboria et al., 2015).

As reported above, nonbelieved memories have been found to occur either following a challenge (i.e., from an experimenter; Clark et al., 2012; Mazzoni et al., 2014; Otgaar et al., 2013), or, in some rare cases, nonbelieved memories have been found to spontaneously occur (see Clark et al., 2013; Mazzoni et al., 2014). More recent research has focused on examining the reasons people report for attenuating their belief for recollected events. In their research, Mazzoni et al. (2010) found that the most common reason people reported for revising their belief that an event occurred was receiving social feedback. That is, these participants had revised their belief that the recollected event had occurred following someone telling them that the recollected event had not occurred. Mazzoni et al. also found that people attenuated their belief for recollections when they had come to believe that the recollected event was implausible and when there was contradictory evidence. Scoboria, Boucher and Mazzoni (2014) specifically examined the reasons people provided for attenuating their belief in recollected events. Scoboria et al. examined 374 samples of nonbelieved memories where participants had provided a reason for attenuating their belief. In line with Mazzoni et al. (2010), Scoboria et al. also found that the most commonly reported reason for people to attenuate their belief that an event occurred was social feedback. In 42.2% ( $n = 158$ ) of cases, social feedback was the primary reason for people attenuating their belief, with participants specifically stating that someone had told them that the event had not occurred at all, or had not occurred as recollected. The remaining reasons, in decreasing order of frequency were: event plausibility (i.e., the recollected event was now considered implausible; 19.5%,  $n = 73$ ), source re-attribution (8.8%,  $n = 33$ ), internal features (7.2%,  $n = 27$ ), external evidence (i.e., seeing a photograph or video; 7.2%,  $n = 27$ ), general beliefs about memory (e.g., meta-memory beliefs; 6.4%,  $n = 24$ ), discrepant with view of self or others (6.4%,  $n = 24$ ), and personal motivation (1.1%,  $n = 4$ ). These results showed that there are many factors which can contribute to the appraisal of belief that an event occurred, but the most commonly reported reason was social feedback.

To summarise, nonbelieved memories are event representations characterised by stronger recollection ratings than belief ratings. One of the most compelling findings from this literature is the link between nonbelieved memories and social feedback. Research seeking to elicit nonbelieved memories has used social feedback resulting in participants attenuating their belief for recent true and false memories and event for recent and distant childhood memories. When people with naturally occurring nonbelieved memories are asked to report reasons for attenuating their belief, the most

commonly reported reason is social feedback. These findings suggest that belief is most susceptible to revision following social feedback. In our research we draw parallels between the social feedback used to elicit nonbelieved memories, and the use of social feedback to elicit omission errors.

## BELIEF, ATTITUDES AND BEHAVIOUR

Recent research has shown that it is important to make a distinction between belief and recollection. Researchers have suggested that it is important to examine whether belief or recollection drives behaviour (Nash & Takarangi, 2011, Smeets, Merckelbach, Horselenberg, & Jelicic, 2005). Autobiographical memories are often assumed to affect our behaviour (Nelson, 1993), but recent research has shown that coming to believe an event occurred in the past is more influential than recollection (Bernstein et al., 2015).

The focus of the current research is on the consequence of having a recollection when belief has been attenuated. Researchers have shown that suggestion can influence peoples' behaviours and attitudes. Scoboria, Mazzoni and Jarry (2008) suggested to 21 participants that as children that they had become ill after eating peach yoghurt which had been contaminated with bacteria. Participants in the experimental condition were told that they were 96% likely to have become ill after eating peach yoghurt, while participants in the control condition were told that they were only 53% likely to have become ill after eating peach yoghurt. One week later, participants returned to the lab for what they believed was an unrelated marketing experiment. Participants were asked to taste-test an unrelated food (crackers) and three different flavours of yoghurt, including peach yoghurt. After tasting each yoghurt, participants were asked to rate the appearance, odour, taste, texture of each yoghurt, and also state how much of each yoghurt they would like to eat, and how much they liked the food. The experimenter then told participants that the remaining yoghurt would be thrown away at the end of the session, so they could consume as much of the yoghurt as they wanted. The results showed that the participants who had received the suggestion that they had likely become sick after eating peach yoghurt, ate less peach yoghurt in the taste-test than participants who had received the 53% likely information.

Other related research in this area by Laney, Morris, Bernstein, Wakefield, and Loftus (2008) found that participants who came to falsely believe that, as a child, they had a positive experience with asparagus, were willing to pay more for asparagus when shopping than participants who did not come to believe the positive experience had occurred. Likewise, coming to believe that you became ill after eating boiled eggs or dill pickles can reduce your willingness to eat these foods (Bernstein, Laney, Morris, & Loftus, 2005). These two experiments are an example of how coming to *believe* an event occurred in the absence of a specific recollection can influence subsequent behaviour (see also Ost, in press).

Researchers have demonstrated that findings, such as those found by Scoboria et al. (2008) are driven by belief, and not recollection. Using a similar procedure to Scoboria et al., Bernstein et al. (2005) suggested to 180 participants that they had become ill after eating hard-boiled eggs ( $n = 91$ ) or dill pickle ( $n = 89$ ). One key difference in this experiment was that participants were also asked to state whether they actually remembered becoming ill, whether they believed they had become ill, or whether they did not believe they had experienced the illness. In coding this data, participants were categorised as a believer when they reported having a memory or a belief that they had become ill, and only if their confidence that the illness occurred had increased. This resulted in 25% of participants in the egg condition being classified as believers, and 31% in the dill pickle condition. The results showed that those categorised as 'believers' showed the greatest avoidance towards the foods which had been suggested to have caused their illness. This research demonstrates that developing a false belief that you had a negative experience with a food, results in behavioural consequences.

More recently, Bernstein et al. (2015) have conducted a mega-analysis which pooled together the data from eight experiments ( $N = 1369$ ) examining the effect of false belief on attitudes and behaviour. The results showed that suggesting that participants had a positive or negative experience with a particular food influences the participant's preference ratings for that food. The suggestion also influenced participant's belief that the event had occurred, which in turn influenced participant's future intention to consume the food. Finally, believing that the experience occurred, irrespective of whether participants recollected the experience, had a similar effect. This research demonstrated the significant influence that belief could have on subsequent attitudes and behaviour.

Taken together, this research shows that belief is influential on our behaviour. However, to date, this research has only focused on the consequence of having a belief. It, therefore, remains to be seen whether recollection in the absence of a belief can have a consequence, such as omission errors (Mazzoni et al., 2014; Otgaar et al., 2014). Given that recollection is assumed to be accompanied by belief (e.g., Brewer 1996; Mazzoni & Kirsch 2002; Scoboria et al., 2004), it is not surprising that recollection is assumed to drive behaviour (Nelson, 1993). However, it seems plausible to argue that there could be consequences to not-believing. For example, would someone with a nonbelieved memory report such a memory freely? That is the central question in this thesis.

## PEOPLE STRATEGICALLY REGULATE THEIR MEMORY OUTPUT

We often assume that when people are not able to provide a memory, it is because they either never had the information to begin with, or we think they have forgotten. However, research has shown that even when people do recollect information, they can still decide whether or not to report this information. Koriat and Goldsmith (1996) have proposed a model of the strategic regulation of memory accuracy in which they argue

that people have direct control of their memory output. The model they propose consists of two mechanisms: a monitoring mechanism that is used to assess a response for correctness, and a control mechanism which is used to make a decision to provide or withhold an answer. More specifically, Koriat and Goldsmith's model proposes that when embarking upon a memory search, there is a parallel process of monitoring all possible responses for the probability that it is the correct one (the 'best candidate'). This probability, that the best candidate is correct, is then compared with an internally derived response criterion which determines whether the best candidate is an answer which should be volunteered. However, before volunteering an answer, the rememberer also considers the potential cost of reporting a correct or incorrect response. Koriat and Goldsmith demonstrated this by showing that when participants were incentivised to be accurate and told that an incorrect response would be penalised, participants were more likely to withhold responses which they held with low confidence. However, when participants were confident in a response they were more likely to provide the response. Koriat and Goldsmith assumed that confidence was the criterion measure. However, researchers have proposed that confidence and belief in accuracy are "conceptual relatives" (Scoboria et al., 2015, p. 339). This relation comes in how belief in accuracy is defined as an assessment that recollected details are believed to be accurate. Confidence is also an assessment that a recollection is accurate. This suggests that we could expect belief in accuracy to be used in a similar way to confidence. When belief is attenuated, we would, therefore, expect participants to withhold information, resulting in omission errors.

## OUTLINE OF THE EXPERIMENTS REPORTED IN THIS THESIS

The aim of the current research is to examine whether omission errors are freely reported. While research has shown that, when specifically asked to recall a nonbelieved memory, 20% of people reported having a nonbelieved memory (Mazzoni et al., 2010). However, other research (Scoboria & Talarico, 2013) showed that only 3% of personal memories reported were nonbelieved memories. These findings suggest that people might be more likely to omit nonbelieved memories.

This thesis first starts with the presentation of an experiment to demonstrate the ease by which nonbelieved memories can be experimentally evoked by using social feedback. This experiment is described in Chapter 2. The reason for describing this experiment is to show that social feedback—which will be used in other experiments—is a strong catalyst in producing nonbelieved memories. Next, in this thesis, we report four experiments in which we sought to examine whether nonbelieved memories resulted in the occurrence of omission errors. While previous research has examined either omission errors (Merckelbach et al., 2007; Wright et al., 2001) or nonbelieved memories (Clark et al., 2012; Mazzoni et al., 2014; Otgaar et al., 2013), the general aim of our

## Chapter 1

experiments was to elicit omission errors and simultaneously also measure belief and recollection.

Based on the literature reviewed above, the elicitation of omission errors and non-believed memories share some common factors, yet an examination of both omission errors and belief and recollection remains unexplored. Throughout this research, we propose that omission errors could occur when people have attenuated their belief, but not their recollection of a past experience. Over four experiments, we adopted and adapted previously reported procedures for eliciting omission errors, but also included measures of belief and recollection.

In Experiments 1 and 2, we adapted the procedure used by Wright et al., (2001) to elicit omission errors. However, we expand upon the procedure used by Wright et al. in that we also asked participants to rate the strength of their belief and recollection. As in Wright et al. we examined omission errors occurring in both a test of free recall and recognition. These experiments are presented in Chapter 3 of this thesis.

Experiment 3 and 4 use the social contagion paradigm used by Merckelbach et al. (2007) to elicit omission errors. Again, unlike previous research using the social contagion paradigm, we again asked participants to provide belief and recollection ratings. These experiments are presented in Chapter 4 of this thesis.

## Chapter 2

### Eliciting Nonbelieved Memories Creating Nonbelieved Memories for Recent Autobiographical Events

This research is published in the journal PLoS One:  
Clark, A., Nash, R. A., Fincham, G., & Mazzoni, G. (2012). Creating non-believed memories for recent autobiographical events. PLoS ONE, e32998  
<http://dx.doi.org/10.1371/journal.pone.0032998>.

## OVERVIEW

Research suggests that many people spontaneously report vivid memories of events that they do not believe to have occurred. In the present experiment we tested for the first time whether, after powerful false memories have been created, debriefing might leave behind nonbelieved memories for the fake events. In Session 1 participants imitated simple actions, and in Session 2 they saw doctored video-recordings containing clips that falsely suggested they had performed additional (fake) actions. As in earlier experiments, this procedure created powerful false memories. In Session 3, participants were debriefed and told that specific actions in the video were not truly performed. Beliefs and memories for all critical actions were tested before and after the debriefing. Results showed that debriefing undermined participants' beliefs in fake actions, but left behind residual memory-like content. These results indicate that debriefing can leave behind vivid false memories which are no longer believed, and thus we demonstrate for the first time that memory of the event can be experimentally dissociated from the belief in the event's occurrence. These results also confirm that belief in and memory for an event can be independently-occurring constructs.

## INTRODUCTION

Counter-intuitive as it might sound, people do not always believe that the events they remember really occurred. Many people report having a memory that they know to be false (Mazzoni et al., 2010), and in some cases, these memories can concern extremely significant experiences. For instance, there are documented cases of people with memories of severe childhood abuse having encountered incontestable proof that the events they recall could not possibly have happened (Mazzoni & Kirsch, 2002). Here we report on an attempt to experimentally create *nonbelieved memories* in the lab by systematically stripping people's memories of their underlying beliefs.

Theoretical accounts of autobiographical memory and constructive memory processes have increasingly focused on believing as a foundation and precursor to remembering (Mazzoni & Kirsch, 2002; Mazzoni et al., 2001; Smeets et al., 2005). Scoboria et al. (2004), for example, proposed a nested structure for autobiographical reasoning, whereby if an event is remembered then it will also be believed to have occurred, and if it is believed to have occurred, it will also be seen as plausible. Conversely, an event can be judged as plausible in the absence of belief, and can be believed to have occurred in the absence of a memory. This experiment (Scoboria et al., 2004) offered empirical support for this nested model: specifically, their participants gave ratings of plausibility, belief and memory for ten specific events that they might have experienced in childhood. The results showed that ratings were almost always higher for plausibility than for belief, which in turn was rated higher than memory. Indeed, participants gave belief ratings that were equal to or greater than their memory ratings on 95.7% of occasions.

It seems clear that the nested model provides a good account of the relationship between belief and memory. But what about the remaining 4.3% of events rated by participants in Scoboria et al.'s experiment where participants gave memory ratings that were higher than their belief ratings? Is this small percentage attributable merely to random error? It would appear not. In fact, there is both anecdotal and empirical evidence that nonbelieved memories do occur.

Perhaps the best-known anecdotal report of a nonbelieved memory was reported by Piaget (1951), who vividly recalled being the victim of an attempted kidnapping in infancy. Thirteen years after this purported crime, Piaget learned that the whole event was a fiction fabricated by his nanny; yet Piaget maintained that he could still 'remember' it occurring. To explore incidences like Piaget's, Mazzoni et al. (2010) recently reported the first empirical experiment of nonbelieved memories. The authors asked 1,593 undergraduates whether they could remember an event that they did not believe happened. Nearly a quarter of the sample reported having a memory of this type, thus establishing the status of nonbelieved memories as more than exceptional anecdotal oddities.

Mazzoni et al. (2010) asked their participants about the characteristics of their nonbelieved memories and found that these memories, in fact, had many phenomenologi-



cal similarities with 'regular' believed memories. For example, both types of memory were rated similarly in terms of visual characteristics, emotional richness, and the feeling of 'reliving' and mental time-travel. Contrastingly, nonbelieved memories differed from believed memories on several other characteristics such as auditory quality and the sense of significance. These results led the authors to conclude that nonbelieved memories are experienced as genuine memories in many respects.

Mazzoni et al.'s (2010) data are intriguing and informative, but to understand nonbelieved memories better, and thus to gain a stronger insight into the role of beliefs in memory construction, it would be beneficial to be able to create these memories experimentally. To consider how we might create nonbelieved memories, one should consider why people stop believing in their memories. Respondents gave numerous reasons, but the most commonly reported reason was that someone else informed them that the event did not occur (Mazzoni et al., 2010). Similarly, in experiments examining the effect of co-witness influences upon memory, participants who remember particular details are often far less likely to privately report those memories after they receive feedback from a confederate denying the presence of those details (Merckelbach et al., 2007). An analogous process to this occurs after the experimental phases of false-memory research when the experimenter debriefs participants at the end of the experiment. Debriefing after a suggestive procedure might thus be one method for experimentally creating and exploring nonbelieved memories, and was thus the focus of the present experiment.

Testing the effects of debriefing on beliefs and memories is important for two reasons. First, as we have outlined, debriefing could provide a way to create and thus to systematically investigate nonbelieved memories. Second, and more broadly, it raises the practical question of whether participants in false memory experiments tend to leave those experiments with the effects of the induction fully reversed by the experimenter's debriefing. In other words, does debriefing successfully 'undo' participants' false memories, or does it simply 'undo' their beliefs, leaving nonbelieved memories intact?

In the present experiment, we used Nash and colleagues' doctored-video procedure to induce false memories in participants (Nash, Wade & Brewer, 2009a; Nash et al., 2009b): participants saw doctored video clips that purported to 'prove' they had performed actions that they did not truly perform. A few hours later they were fully debriefed, after which we re-assessed their beliefs and memories to see whether their false memories were 'still there'. At this point, we also assessed the characteristics of participants' beliefs and memories. Using this doctored-video procedure has at least two benefits for our purposes: First, the procedure has been shown to induce high rates of strongly held false beliefs and memories, as compared with other false-memory paradigms such as the imagination inflation procedure that tend to induce significant but small confidence increases (Garry, Manning, Loftus & Sherman, 1996; Mazzoni & Memon, 2003). Second, in Nash et al.'s experiment, many participants made informal

remarks after debriefing that they could ‘still remember’ performing the false actions that were suggested. This observation gives credence to the hypothesis that debriefing after the doctored-video induction could leave nonbelieved memories behind.

The results of the experiment confirm the prediction that the debriefing in a false memory experiment leaves behind memory-like experiences for recent events. These are probably mental images that to a large extent feel like genuine memories, even though the belief in those mental images is substantially reduced by the debriefing. It also revealed that Nash et al.’s paradigm produces a smaller number of nonbelieved memories before the debriefing, thus creating clear memories for actions that participants are not very certain to have performed. These data confirm that memories and beliefs are independently-occurring constructs and as such can be manipulated independently.

## MATERIALS AND METHOD

### *Participants and Design*

Twenty participants (18 female) completed all sessions of the experiment; their ages ranged from 18-54, ( $M = 24.15$ ,  $SD = 9.13$ ). Participants who studied psychology were compensated with course credits; non-psychology students participated voluntarily without compensation. The experiment had a within-subjects design, with critical action type (performed, fake, new) and session (Session 2 pre-debriefing, Session 3 post-debriefing) as the manipulated variables.

### *Materials and procedure*

We selected 42 of the simple actions from Nash et al. (2009b), for use in the various stages of this experiment. From these, we selected six actions to be critical actions (*clap your hands*, *click your fingers*, *rub the table*, *salute*, *cover your face with your hands*, and *flex your arm*). The critical actions were selected on the basis that they were neither highly memorable nor unmemorable, based on the ratings collected in the Nash et al. experiment. These six actions were randomly divided into three pairs that were assigned—counterbalanced across participants—as the performed, fake and new critical actions. Performed critical actions were genuinely performed by participants in Session 1; fake actions were not performed, but doctored evidence presented in Session 2 suggested that they were indeed performed; new critical actions were neither performed nor suggested, but appeared only in the belief and memory questionnaires in Sessions 2 and 3, and were used as a control.

### SESSION 1

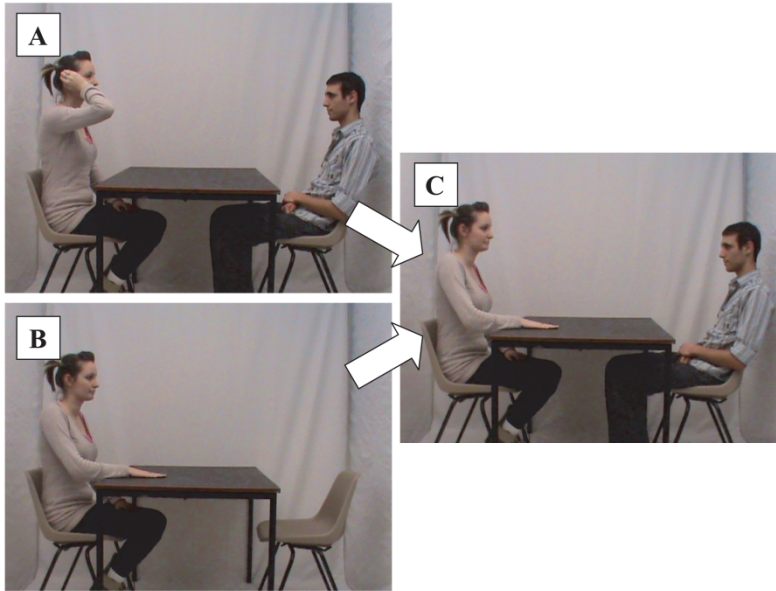
The procedure used here was modelled after the procedure used by Nash et al. (2009a) and Nash et al. (2009b). Participants were greeted by a researcher and informed that the experiment was investigating people's ability to mimic others' actions. They were told that their task would involve observing the researcher performing a series of actions, and then copying the actions themselves. They were also informed that they would be video-recorded as they completed this task. After gaining consent, the researcher and participant sat at a table facing each other, and with the video camera directed toward them both. The researcher started filming the session and began by performing a simple action for 12 seconds. After this period, the participant was then required to copy the action they had seen for a further 12 seconds. Next, the researcher performed a second action, and this 'observe—copy' process continued until both the researcher and the participant had performed 26 actions, including the 2 critical actions that had been assigned as 'performed actions'. The 24 non-critical actions were performed in a single randomised order in all participants' sessions, as these were essentially fillers. The critical performed actions were always performed in the 9th and 17th position of the sequence.

After completing all 26 actions, the participant was thanked and reminded to return for Session 2. Once the participant had left the room, the researcher returned to the table and filmed himself performing the two critical actions that had been assigned as fake actions. The researcher performed each of these for 12 seconds while seated in the same position as he had sat while the participant was present.

#### *Preparing the video-sequences*

Following Session 1, we used Adobe After Effects software to doctor two clips from the video-recording. As in Nash et al. (2009a, b), and as depicted in Figure 2, each doctored clip was created by digitally combining two genuine clips: one that showed the researcher performing a critical action *after* the participant had left the room, and one that showed the participant passively observing a different action. The images from these clips were combined to produce composites that seemed to prove that the participant had in fact observed the two fake actions. Because participants also performed all of the actions they observed, these clips were therefore designed to persuade participants that they had also performed these two actions. Next, we used Adobe Premier Pro to embed these doctored clips into a longer sequence of clips taken from the genuine recording. The full sequence comprised clips of the two fake actions, the two performed critical actions and eight other non-critical performed actions as fillers; all participants saw the same eight filler actions. All 12 clips were 10-seconds in length, and separated by 5-second pauses during which the screen was blank; thus the full video sequence lasted just under 3 min. We did not want the critical actions to be highly sali-

ent in the video sequence; the performed critical actions were thus placed in positions 3 and 7 and fake actions in positions 5 and 10 of the video sequence.



**Figure 2:** Video manipulation; (A) Real clip, (B) Fake action, (C) Doctored composite of (A) and (B).

## SESSION 2

Participants returned for Session 2 two days after Session 1. In this session participants were shown their 3-min video-sequence twice through. To ensure participants paid attention to the actions in the video, on the first viewing they were asked to note down how many times they thought they performed each action in a week. On the second viewing, participants were asked to name each action. Participants next completed a 5-min filler task (solving anagrams), after which they completed two questionnaires that asked whether they *believed* and *remembered* that they performed various specific actions during Session 1. Participants completed the memory questionnaire first: this questionnaire listed 28 actions including 22 non-critical fillers (of which 10 were performed in Session 1 and 12 were new) and the 6 critical actions. For each action, participants used an 8-point scale to rate their memory, in response to the question “How strongly do you *remember* performing this action in Session 1?” Following the memory questionnaire, participants completed the belief questionnaire, which comprised the same 28 actions in a different order. Here, participants again used an 8-point scale to answer the question “How strongly do you *believe* you performed this action in Session 1?” In both questionnaires, a rating of ‘8’ signified a strong belief or memory. Our initial

piloting showed that participants understood the distinction between belief and memory better when the memory questionnaire was administered first, and so we did not counterbalance this ordering. Doing so might have negated a possible confound insofar as people's belief ratings might have been influenced by their memory ratings; however, for the purpose of this exploratory experiment, we decided it preferable that participants were fully able to understand the conceptual difference. After completing these questionnaires, participants were again thanked and reminded to return for Session 3.

### SESSION 3

Participants returned for Session 3 approximately 4 hours after Session 2. In this session, we explained to participants that some of the video clips they saw in Session 2 had been doctored, and we told them which clips were the fakes. For each of the six critical actions, participants were then asked to provide new belief and memory ratings using the same scales as in Session 2. Finally, participants completed a questionnaire probing the phenomenological characteristics of their memories. For each of the six critical actions, they were asked to rate 25 memory characteristics on 7-point scales.

### RESULTS

In the following section, we present our findings in four stages. First, we examine the data measuring participants' beliefs and memories for critical actions in Session 2, and we look for evidence of nonbelieved memories among these reports. Second, we conduct the same analyses on the comparable data from Session 3. Third, we look at the changes in participants' ratings between Session 2 and Session 3.<sup>1</sup> Fourth, we analyse the phenomenology data collected in Session 3.

#### *Beliefs and memories, pre-debriefing*

As a manipulation check, we were first interested to find whether our doctored videos led participants to believe or remember they performed the fake actions. To this end, we examined participants' action ratings from Session 2; these are represented in the first column of data in Table 1. A one-way repeated measures ANOVA revealed signifi-

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<sup>1</sup> We also analysed the data with two repeated measures factorial ANOVAs, including Session (Session 2 vs. Session 3) as a within-subjects variable. The results were wholly consistent with those reported here, with large Critical Action Type x Session interaction effects both for Belief ratings,  $F(2, 38) = 20.00$ ,  $p < .001$ ,  $\eta^2_p = .51$ , and Memory ratings,  $F(2, 38) = 8.73$ ,  $p = .001$ ,  $\eta^2_p = .32$ . For ease of interpretation we report the outcomes of separate analyses of Session 2 data, Session 3 data, and change-scores.

cant differences in belief ratings across critical action types,  $F(2, 18) = 73.43, p < .001, \eta^2_p = .89$ . Follow-up paired sample  $t$ -tests showed that performed critical actions were rated significantly higher than both new critical actions,  $t(19) = 10.76, p < .001, d_z = 2.41$ , and fake actions,  $t(19) = 2.32, p = .03, d_z = 0.52$ . Importantly, fake actions were rated significantly higher than new critical actions  $t(19) = 8.99, p < .001, d_z = 2.01$ , which shows that our doctored videos had the intended effect on beliefs. The same pattern of results held for memory ratings: there were significant differences across critical action types  $F(2, 18) = 62.50, p < .001, \eta^2_p = .87$ . Performed critical actions were rated significantly higher than both new critical actions,  $t(19) = 11.37, p < .001, d_z = 2.54$ , and fake actions,  $t(19) = 3.37, p < .01, d_z = 0.75$ , but fake actions were rated significantly higher than new critical actions,  $t(19) = 7.23, p < .001, d_z = 1.62$ . Together these findings support those of Nash et al. (2009a, 2009b) and showed that the doctored-video procedure was effective at distorting participants' beliefs and memories for their actions.

We also assessed whether participants reported any nonbelieved memories in this session. Recall that in Scoboria et al. (2004), participants gave memory ratings that were higher than their belief ratings on just 4.3% of occasions. In Session 2 of the present experiment, memory ratings were higher than belief ratings on 14.2% of occasions (10% of performed critical actions; 15% of fake actions; 17.5% of new critical actions). This frequency of nonbelieved memories is considerably higher than Scoboria et al.'s figure.

**Table 1.** Mean belief and memory ratings assigned to critical actions before and after debriefing.

		Before debriefing		After debriefing		Change (After – Before)	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Belief	Performed actions	7.15	1.34	6.48	1.40	-0.68	1.13
	Fake actions	5.93	1.83	2.63	1.90	-3.30	2.84
	New actions	2.20	1.27	2.83	2.05	+0.63	1.78
Memory	Performed actions	7.30	1.13	6.48	1.63	-0.83	1.26
	Fake actions	5.78	1.92	3.73	1.87	-2.05	2.43
	New actions	2.33	1.48	2.55	1.83	+0.23	1.96

Random variations in participants' ratings might account for many of the nonbelieved memories when assessed in this way, particularly because unlike Scoboria et al. we administered the belief and memory questionnaires separately. For this reason, we also examined our data with more stringent criteria. First, we classified responses as nonbelieved memories only if the memory rating was at least 2 scale-points higher than belief rating. This pattern held on 10.8% of occasions (7.5% of performed critical actions; 12.5% of fake actions; 12.5% of new critical actions). When the difference was required to be 3 or more scale-points, the overall rate was 5.8% (5% performed, 5% fake, and 7.5% new).

*Beliefs and memories, post-debriefing*

At the start of Session 3, we asked participants to guess what the aim of the experiment was. Only one participant guessed a hypothesis involving false memory or doctored videos; this participant was removed from the analysis and replaced with another participant.

We now turn to examining whether debriefing influenced people's beliefs and memories and whether it created any nonbelieved memories. To this end, we began by examining participants' belief and memory ratings from Session 3, after they had been debriefed. These results are reported in the middle column of data in Table 1. A one-way repeated measures ANOVA on the belief ratings again revealed significant differences across action types,  $F(2, 18) = 38.56, p < .001, \eta^2_p = .81$ . Performed critical actions were rated higher than both new critical actions,  $t(19) = 7.42, p < .001, d_z = 1.66$ , and fake actions,  $t(19) = 8.16, p < .001, d_z = 1.83$ , but this time fake actions were no longer rated higher than new critical actions in terms of belief,  $t(19) = -0.42, p = .68, d_z = 0.09$ . In other words, the debriefing appeared to undo the effect of the doctored video clips on participants' beliefs. Results were partly different for memory ratings. An ANOVA revealed significant differences in memory ratings across critical action types,  $F(2, 18) = 41.29, p < .001, \eta^2_p = .82$ . As before, performed critical actions were rated higher than new critical actions,  $t(19) = 9.30, p < .001, d_z = 2.08$ , and fake actions,  $t(19) = 5.09, p < .001, d_z = 1.14$ , but unlike the pattern with the belief ratings, memory ratings for fake actions remained significantly higher than those for new critical actions,  $t(19) = 2.70, p = .01, d_z = 0.60$ . That is to say, the debriefing did not undermine participants' memories of fake actions to the same extent as it undermined their beliefs.

These analyses suggest that debriefing might have created some additional nonbelieved memories. To assess whether this was the case, as for Session 2 we examined participants' Session 3 ratings to see how often their memory ratings exceeded their belief ratings by at least one scale-point: the criterion used in Mazzoni et al. (2010). Overall, this occurred for 26.7% of critical actions (20.0% of performed critical actions; 42.5% of fake actions; 17.5% of new critical actions). As compared with the Session 2 data, following debriefing there were significantly more nonbelieved memories of fake actions,  $z = 2.30, p = .02$ . The same was not true of performed critical actions,  $z = 1.16, p = .25$ , or new critical actions,  $z = 0.00, p = 1.00$ . Indeed, as Table 1 illustrates, after debriefing the memory ratings were significantly *greater* than the belief ratings only for fake actions,  $t(19) = 3.51, p < .01, d_z = 0.79$ ; in all other conditions the belief and memory ratings did not significantly differ (for all contrasts,  $t < 1.1, p > .29, d_z < .25$ ).

When the more stringent criterion to measure nonbelieved memories (memory minus belief  $\geq 2$  scale-points) was used, a lower number of nonbelieved memories was obtained (14.2% overall), but the decrease was mostly for performed (5%) and new critical actions (7.5%). For fake actions, memory ratings were at least two points higher than belief ratings on 30% of occasions. A similar pattern was found when the even

more stringent criterion of  $\geq 3$  scale-points was used, with 10.8% of nonbelieved memories overall. Still, 25% of the fake actions met this criterion, but only 5% of the performed critical actions and 2.5% of the new critical actions. It is, therefore, clear that our false memory induction and debriefing procedure substantially increased the incidence of nonbelieved memories even when a highly stringent classification criterion was used.

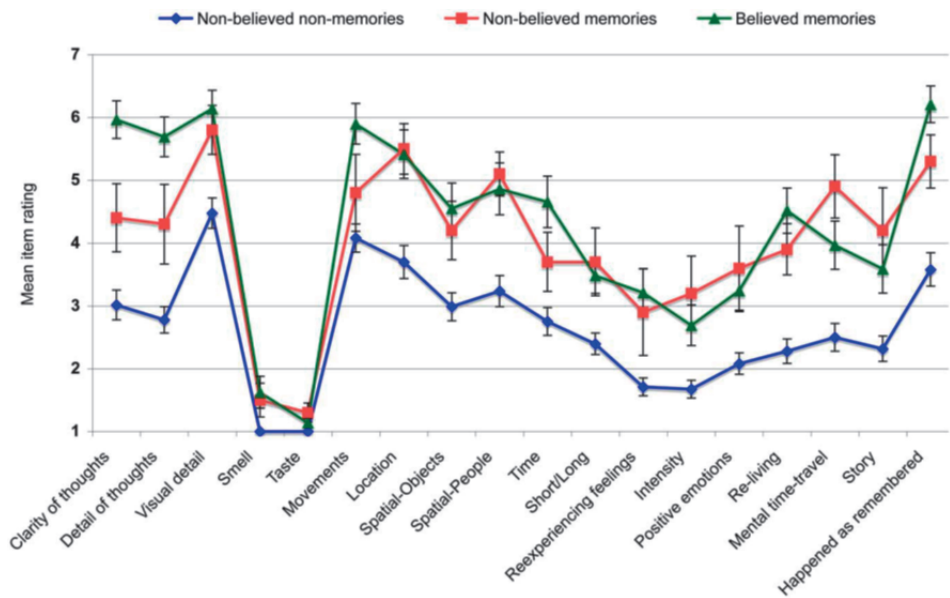
### *Change-scores*

To explore our findings in more depth, we calculated change-scores by subtracting participants' belief and memory ratings given at Session 2 from their ratings given at Session 3. These change-scores are shown in the third column of data in Table 1 and provide a measure of the effect of debriefing on beliefs and memories. One-sample  $t$ -tests showed that with regard to performed critical actions, the change-scores were significantly below zero for both the belief,  $t(19) = -2.93$ ,  $p < .01$ ,  $d = 0.60$ , and memory measures,  $t(19) = -2.68$ ,  $p = .02$ ,  $d = 0.66$ . These change-scores for performed critical actions give us an indication of how much deflation in ratings between Sessions 2 and 3 might plausibly be attributed to simple weakening of memory strength and confidence across the time delay. Change-scores for fake actions were also significantly below zero, (Belief,  $t(19) = -5.19$ ,  $p < .001$ ,  $d = 1.16$ , Memory,  $t(19) = -3.78$ ,  $p = .001$ ,  $d = 0.84$ ), but were also significantly greater in magnitude than those for performed critical actions (both  $t$ s  $> 2.5$ , both  $p$ s  $< .05$ , both  $d$ s  $> 0.56$ ). These change-scores, therefore, show that both beliefs *and* memories for fake actions were undermined by debriefing, although the effect on belief was significantly greater than the effect on memory. The change-scores for new critical actions did not differ significantly from zero (Belief,  $t(19) = 0.51$ ,  $p = .61$ ,  $d = 0.11$ ; Memory,  $t(19) = 1.57$ ,  $p = .13$ ,  $d = 0.35$ ).

### *Phenomenological characteristics*

The final element of our analysis was to look at the characteristics of participants' beliefs and memories. Recall that at the end of Session 3, participants rated all six critical actions in terms of 25 memory characteristics. For each of these 25 characteristics, we computed a one-way ANOVA, with critical action type as the repeated measures factor. After making a Bonferroni correction ( $\alpha = .05/25 = .002$ ), these analyses revealed significant differences on 9 of the 25 memory characteristics, including visual detail, feelings, and the experience of re-living. However, follow-up  $t$ -tests with Bonferroni corrections revealed that all of these effects were driven by memory characteristics for performed critical actions being clearer than for fake and new critical actions. In contrast, there were no significant differences between the characteristics of memories for fake actions and new critical actions.





**Figure 3.** Phenomenological characteristics that differed between nonbelieved memories, believed memories and nonbelieved memories.

To assess whether nonbelieved memories differ in characteristics from other types of belief and memory phenomena, we collapsed the Session 3 data across critical action types, and categorised all 120 critical actions (6 actions x 20 participants) as either a nonbelieved non-memory ( $n = 76$ ), believed non-memory ( $n = 5$ ), nonbelieved memory ( $n = 10$ ), or believed memory ( $n = 29$ ). Responses were classified as ‘beliefs’ whenever participants gave belief ratings of 7 or 8, and also as ‘memories’ whenever they gave memory ratings of 7 or 8. Thus instead of defining nonbelieved memories as before in terms of the size of the difference between memory and beliefs scores, here a nonbelieved memory is defined specifically as a memory rated as 7 or 8, accompanied by a belief rated 6 or below. We conducted a series of one-way ANOVAs to compare the characteristics of different response types; however, we excluded believed non-memories from this analysis due to their low frequency. As represented in Figure 3, our ANOVAs revealed significant differences ( $\alpha = .05/25 = .002$ ) on 18 of the 25 memory characteristics. We were particularly interested in whether nonbelieved memories differed from nonbelieved non-memories (i.e., comparing nonbelieved events with vs. without an accompanying memory), and from believed memories (i.e., comparing memories with vs. without an accompanying belief). Follow-up  $t$ -tests revealed that nonbelieved memories were rated as significantly richer than nonbelieved non-memories on 12 of the 18 measures that had been significant overall; three of these were significant at the Bonferroni-adjusted level ( $\alpha = 0.05/18 = 0.0028$ ): memory for location,  $t(17.88) = 3.76, p = .001, d = 0.98$ , spatial arrangement of people,  $t(19.82) =$

4.36,  $p < .001$ ,  $d = 1.09$ , and feeling of mental time-travel,  $t(84) = 3.75$ ,  $p < .001$ ,  $d = 1.35$ . In contrast, only two characteristics—clarity of thought and details of thought (both  $t$ s  $< 2.61$ , both  $d$ s  $< 0.75$ )—differed between nonbelieved memories and believed memories, and neither remained significant after a Bonferroni-adjustment. These findings—along with a visual inspection of Figure 3—broadly support those of Mazzoni et al. (2010), insofar as they show that nonbelieved memories share many more similarities with believed memories than they do with non-remembered events.

## DISCUSSION

Ours is the first experiment to our knowledge to systematically examine whether the effects of a powerful false memory induction are ‘undone’ when participants are debriefed, or whether nonbelieved memories are left behind. The data provide new evidence—the first experimental evidence—for the proposal that the occurrence of beliefs and memories can be independent. Further building on the work of Mazzoni et al. (2010) in which participants described nonbelieved memories of childhood experiences, the present experiment also represents the first empirical demonstration of nonbelieved memories of *recent* experiences.

Confirming previous results (Nash et al., 2009a), the manipulation used to induce false memories was highly effective. Many false memories for fake actions were obtained: 68% of memory ratings were above the scale-midpoint, and a high percentage (58%) were in the high confidence range (i.e., Memory  $\geq 7$ ). The debriefing manipulation we used significantly increased participants’ tendency to rate their memories for fake actions as stronger than their belief in those actions, a response pattern that previous studies have shown to occur only rarely (Scoboria et al., 2004). This was true even with our most stringent criterion: For 25% of fake actions, memory ratings were at least three points above belief ratings, whereas this was true for just 4% of other critical actions. Indeed, after debriefing, participants’ mean memory ratings for fake actions were significantly higher than their mean belief ratings for those actions (and also higher than their mean memory ratings for new critical actions). These results suggest that after debriefing participants were left with some residual memory-like content for the fake actions that they did not believe to be grounded in genuine experience.

The study of the dissociation between beliefs and memories stems from research on the effects of suggestion, in which often the creation of false beliefs has not been accompanied by false memories (Mazzoni, Loftus, Seitz & Lynn, 1999). This dissociation is important not only in false memories (e.g., Scoboria, Lynn, Hessen & Fisico, 2007) but also in episodic autobiographical memory more generally (Mazzoni & Kirsch, 2002; Scoboria et al., 2004), and for understanding some clinical conditions (Smeets et al., 2005). Previously, the distinction has been conceived as a partial dissociation, in which memories are nested within belief (Scoboria et al., 2004). Here we have shown experi-

mentally that the two are theoretically independent, as the same manipulation affects differently beliefs and memories. This leads to having believed memories (what are usually called episodic memories); believed but not remembered events; nonbelieved memories, and nonbelieved and not remembered events. It is well established that procedures that create false memories often increase beliefs more easily than memories (Mazzoni et al., 1999; Scoboria et al., 2007). Similarly, this experiment shows that procedures that aim at deleting false memories have a greater effect on the belief than the memory. In other words, beliefs seem to be in general more malleable than memories. We are unaware of any theoretical reason to expect gender effects in terms of this relative malleability; however, the low proportion of male participants in the present experiment and the exclusively student sample are limitations to the generalizability of these conclusions that should be addressed in further studies.

Using the 2x2 classification system we explored the phenomenological characteristics of participants' beliefs and memories, to help understand what the word 'memory' might refer to. In the current experiment believed and nonbelieved memories (combined across all action types) did not differ on any measure that reflected a recollective experience. This indicates that nonbelieved memories still maintain a strong sense of recollection (see also Mazzoni et al., 2010) while differing on non-recollective characteristics involving thoughts (*details of thought* and *clarity of thought*). In contrast, several recollective characteristics differed between nonbelieved memories and nonbelieved non-memories; thus, memory, as opposed to belief, could be conceived as recollection. We note, however, that one key experience not assessed here is familiarity, which in some previous studies has been shown to affect belief judgments (Bernstein, Whittlesea & Loftus, 2009; Winkielman & Schwarz, 2001), and in other studies has been shown also to affect memory judgments (Echterhoff & Hirst, 2006; Nash et al., 2009a). Future studies should independently manipulate in the same procedure familiarity and recollection and assess how they relate separately to belief.

One important question that remains unanswered by the present experiment relates to the nature of the independence between belief and memory. Is belief a necessary precursor to memory that can nevertheless be removed afterwards, like scaffolding on a new building? Or, alternatively, can memories form completely in the absence of belief? One might reason that the former hypothesis would be true: a memory-like image that develops in the absence of belief would feasibly be attributed to a dream or to imagination. Indeed, it might be that a belief itself can cause mental images to be attributed to memory; belief could thus be conceptualised as a form of source-monitoring cue in its own right, a conceptualisation that fits with existing theoretical accounts of metacognitive processes in autobiographical memory in which the strength of the belief affects memorial processes. The idea that belief can function as a monitoring cue in its own right also is in line with other attributional models in which non-memorial information (such as perceptual fluency) affects the 'old/new' decision in recognition tasks (Jacoby, Kelley & Dywan, 1989; Whittlesea, Jacoby & Girard, 1990).

Nevertheless, evidence against this interpretation—and in favour of the latter hypothesis—is that many of the nonbelieved memories in our experiment were not a product of our suggestive doctored videos and debriefing: participants occasionally reported nonbelieved memories for fake actions in Session 2, as well as for performed and new actions in Sessions 2 and 3. Thus here nonbelieved (sometimes false) memories have occurred spontaneously and independently of the experimental manipulation. These observations raise the intriguing possibility that memories might indeed sometimes form in the absence of belief. This can occur only if beliefs and memories are the product of different mechanisms.

Finally, our findings have broader implications for memory distortion research. To the extent that debriefing might not always completely ‘undo’ the effects of a suggestive manipulation, we might question the ethics of inducing false memories in experimental participants. Is it ethical for participants to leave research labs with remnants of nonbelieved false memory content in the forefront of their minds? A sensible approach to answering this question might be to consider whether the memories would likely be consequential. For example, it is conceivable that a person who ceased believing in a traumatic experience might nevertheless continue to be traumatised by intrusive mental images experienced as memories. We suggest that for most false-memory paradigms and experiment designs, this is highly unlikely to pose an ethical problem. Nevertheless, how participants might feel about any residual memory content should be an important question for researchers to consider when planning studies.

## SUMMARY OF CHAPTER 2

The results of Clark et al. (2012) presented in this chapter demonstrate that belief in occurrence can be attenuated while leaving recollection relatively intact. Thus, this research provides a clear demonstration that belief in occurrence is dissociable from recollection of recent memories. While the phenomenological data in this research suggest that nonbelieved memories are quite similar to believed memories, should we expect both nonbelieved memories and believed memories to be freely reported in similar ways? Or, since research using a similar manipulation to that used by Clark et al. (2012) has found that omission errors occur (Merckelbach et al., 2007), should we expect nonbelieved memories to be omitted more frequently than believed memories? It is this question that inspired the current thesis and which is addressed in the research presented in the following chapters.



# Chapter 3

## Experiments 1 and 2

Omission errors are not a consequence of not believing

### OVERVIEW

In Experiments 1 and 2, we sought to elicit omission errors using a procedure based on Wright et al. (2001). Participants saw a number of scenes, each showing a collection of household items. After a free recall test where participants had to recall as many items as they could from each scene, participants were either re-presented with the scenes (Expt. 1) or the experimenter read aloud to the participants the items they had recalled (Expt. 2). In these re-presented scenes, some of the items which were originally presented to the participants were withheld. The results showed that omission errors only occurred rarely and both belief and memory ratings were attenuated for omission errors.

Experiments 1 and 2 are presented together in Chapter 3 because these experiments are currently being prepared for publication together.

## INTRODUCTION

Nonbelieved memories refer to autobiographical memories characterised by stronger recollection than belief (Mazzoni, Scoboria, & Harvey, 2010). While nonbelieved memories were initially assumed to be quite exceptional, more recent evidence revealed that one in five people report having such a memory (Mazzoni et al., 2010), and that nonbelieved memories can be elicited in the laboratory (Clark, Nash, Fincham, & Mazzoni, 2012; Mazzoni, Clark, & Nash, 2014; Otgaar, Scoboria & Smeets, 2013). While recent research has sought to examine the characteristics of nonbelieved memories, the current research sought to examine whether nonbelieved memories have any behavioural consequences. Specifically, in this research, we examined whether nonbelieved memories are responsible for instances in which people fail to report experienced events, also called omission errors.

Mazzoni and Kirsch (2002) outlined a metacognitive model which proposed the idea that people can believe an event without necessarily recollecting it. One of the main tenets of Mazzoni and Kirsch's model is that even when people are unable to recollect a past event, they may still believe that it occurred in their past (for example, breaking your arm as a young child) if they have enough information available about the event (e.g., seeing a family photo or a scar). Empirical data supporting Mazzoni and Kirsch's model was reported by Scoboria, Mazzoni, Kirsch and Relyea (2004) who instructed 368 participants to rate ten autobiographical events for how plausible the event was (general plausibility and personal plausibility), their belief that the event had occurred, and the strength of their recollection. The results showed that participants provided highest ratings for general plausibility ( $M = 4.63$ ), followed by personal plausibility ( $M = 3.77$ ). Participants' belief ratings ( $M = 3.19$ ) were lower than their ratings of personal plausibility but higher than their ratings of recollection ( $M = 2.34$ ). This finding suggests that for an event to be recollected, a person must believe it to have occurred, and for it to be believed, it must also be considered plausible. Scoboria et al. described this as the 'nested model', in which memory is nested within belief, and belief within plausibility.

Scoboria et al. (2004) found that the nested relationship between belief and recollection held true for 95.7% of the events, with participants' belief ratings being either equal to or higher than recollection ratings. However, of most relevance to the current research was their finding that for 4.3% of the events rated, participants reported having a stronger recollection than belief. Thus these events were remembered with a stronger recollection than belief that the event had occurred. Examples of such event representations have, anecdotally, been mentioned in the psychological literature. For example, Piaget (1951) reported on a memory he had for almost being kidnapped when he was two years old. Piaget's recollection was so vivid that he recollected details such as scratches caused to his nanny's face as she fought off the attacker. However, when Piaget was 15 years old, he learned that this event had never happened. Taken together, the account provided by Piaget and the small number of recollections found by



Scoboria et al. (2004) suggested that people are able to vividly recollect events even when their belief that the event occurred is low.

The term nonbelieved memory was coined by Mazzoni et al. (2010). To understand these memories further, Mazzoni and colleagues asked 1593 undergraduate students to indicate whether they had a recollection of an event that they no longer believed had occurred. Strikingly, 349 (21.91%) of these participants reported that they had a nonbelieved memory. Of those participants with nonbelieved memories, 98 went on to provide further details of their recollection, including specific details about what had caused them to attenuate their belief that the event had occurred. Participants were also asked to recall (i) an event which they still believed had occurred, and (ii) an event which they believed had occurred, but for which they had no specific recollection (e.g., a family story) both from around the same age as the event in their nonbelieved memory. Also, participants were asked to rate the phenomenological characteristics of each of these memories (e.g., quality of visual details, emotional valence and ability to mentally re-live the event). The results showed that nonbelieved memories received similar phenomenological ratings as believed memories. For example, both believed memories and nonbelieved memories were characterised by the ability to form clear visual and other perceptual details, including the spatial arrangement of people and objects. In more than half of the cases (56%) participants indicated that they had attenuated their belief that the event had occurred following social feedback (i.e., someone told them that the event had not occurred). Another commonly reported reason for people attenuating their belief was that the event lacked plausibility (36%). Finally, receiving contradictory evidence (e.g., no scar where one should be) was the third most common reason for attenuating belief (7%). This research demonstrates that nonbelieved memories are more common than once thought, and that nonbelieved memories share many of the characteristics of memories for events which are still strongly believed to have occurred.

Subsequent research has demonstrated that nonbelieved memories can be experimentally elicited in the laboratory. Clark et al. (2012) showed participants doctored video evidence suggesting they had performed actions which in fact they had not performed. Some of these participants then developed 'false' memories for having performed those actions. The researchers then 'debriefed' participants by explaining to them how they had come to falsely remember performing these actions. Both before and after debriefing, participants rated the strength of their belief and recollection for performing the actions. The authors found that following debriefing, participants' belief ratings for the false actions decreased significantly (cf. before debriefing), while recollection both before and after debriefing remained at similar strength. This experiment was the first to demonstrate that belief and recollection can be experimentally dissociated (see also Otgaar, Scoboria & Smeets, 2013 for an example using childhood memories with adult and child participants).

While Clark et al. (2012) and Otgaar et al. (2013) demonstrated that nonbelieved memories occur when false memories are challenged, similar results have been observed when participants' true memories are challenged. Mazzoni et al. (2014) used a similar procedure to that used by Clark et al. (2012), but instead of challenging false memories, the memories challenged were of genuinely performed actions. Their results also showed that the 'debriefing' delivered by the experimenter resulted in participants attenuating their belief that they had performed these actions while their recollection of performing the actions remained high. Otgaar et al. (2016) also found a challenge to participants' true and false memories by an experimenter resulted in the participants attenuating their belief, but this effect was larger for false memories than for true memories.

While past research has assumed both belief and recollection are required for remembering (e.g., Brewer, 1996), the research described above demonstrates that recollecting the past and belief that events actually occurred in the past are dissociable components of remembering the past. It is possible for someone to believe an event occurred, but with little recollection (Mazzoni & Kirsch, 2002; Scoboria et al., 2004), and it is possible for someone to recollect an event after their belief has been attenuated (Mazzoni et al., 2010; Clark et al., 2014, Mazzoni et al., 2014; Otgaar et al., 2013). Making a distinction between recollection and belief has prompted some researchers to question whether recollection or belief has a greater influence on our behaviour (Nash & Takarangi, 2011, Smeets, Merckelbach, Horselenberg, & Jelicic, 2005).

Our behaviours are often attributed to our memories of the past (Nelson, 1993). However, research has shown that participants who develop a false belief about having a positive (Laney, Morris, Bernstein, Wakefield, & Loftus, 2008) or negative (Bernstein, Laney, Morris, & Loftus, 2005) experience with a food in the past, have also shown subsequent behavioural consequences. For example, participants who come to believe that they had a positive experience with asparagus when they were children were more willing to order asparagus in a restaurant and pay more for asparagus when shopping (Laney et al., 2008). A recent mega-analysis (Bernstein, Scoboria, & Arnold, 2015) has confirmed the robustness of these findings.

In the current experiments, we were interested in the consequence of having a recollection for which belief had been attenuated. Specifically, we examined whether eliciting nonbelieved memories would result in the occurrence of omission errors. Omission errors occur when people fail to report items of information. It has been demonstrated that some suggestive and misleading techniques can cause participants to omit information more frequently than participants not exposed to the suggestive or misleading information (Merckelbach, Van Roermund, & Candel, 2007; Wright, Loftus & Hall, 2001). For example, Merckelbach et al. found that when a confederate challenged a participant's recollection of items present in a scene, participants omitted these challenged items more frequently than participants in a control condition who were not challenged by a confederate. Researchers have speculated that eliciting nonbelieved

memories could also elicit omission errors (Mazzoni et al., 2014; Otgaar, Scoboria & Mazzoni, 2014). Specifically, Mazzoni et al. (2014) use the term ‘negative misinformation’ to describe their ‘debriefing’ manipulation. Mazzoni et al. define negative misinformation as post-event information which suggests an event never occurred. They also argue that negative misinformation may have been responsible for omission errors in other research (e.g., Merckelbach et al., 2007).

One experiment demonstrated that simply re-presenting participants with a previously seen set of drawings, but with some drawings ‘withheld’ resulted in omission errors on a recall and recognition memory test. Wright et al. (2001, Expt. 1) asked participants to copy a series of 12 drawings that depicted a man and a woman going on a date. For example, one drawing showed the couple entering a restaurant, while another showed them looking at the menu and so on. One week later, participants received what they were told was another participant’s copy of the drawings. For participants in the omit condition, one of the 12 drawings they had originally seen was left out (e.g., the drawing showing the waitress taking the couple’s order). For participants in the *add* condition, a new drawing was included which they had not originally seen (e.g., a man playing the guitar for the couple). When participants were asked to recall the drawings they had originally seen, 56% of participants in the *omit* condition failed to report the omitted drawing compared with 33% in the control condition. More strikingly, 34% of participants in the *omit* condition failed to recognise the omitted drawing compared with 16% in the control condition. In the *add* condition, 20% of participants falsely recalled the new drawing, compared with 6% in the control condition. Similarly, the new drawing was falsely recognised as being part of the original series by 46% of participants in the *add* condition, compared with 36% in the control condition. There are two interesting findings here, first that omission errors occurred at a similar rate to additions to memory. Second, omissions occurred not just for recall memory, but also for recognition memory.

Wright et al. (2001) explained their results in relation to retrieval-induced forgetting (e.g., Anderson, Bjork & Bjork, 1994). Retrieval-induced forgetting occurs when participants are asked to recall only part of a to-be-remembered stimuli. For example, Anderson et al. (Expt. 1) demonstrated retrieval-induced forgetting by having participants recall some items from a category of previously studied words (e.g., FRUITS: orange, banana, lemon). In a subsequent category-cued recall test, participants recalled fewer of the items which had not been practised from the practised category. Retrieval-induced forgetting effects are explained in terms of retrieval inhibition. When some items of a category are practised, there is also competition from the related but non-practised items from within the category. To reduce the risk of erroneously reporting the non-practised items during the retrieval practice, inhibitory control processes inhibit the non-practised items, making them harder to recall in a subsequent memory test. In Wright and colleagues’ experiment, participants in the omit condition would have to inhibit interference from the omitted drawing during the second phase of the experi-

ment, making this item more difficult to recall and recognise in the subsequent memory tests.

Here, we consider the possibility that omission errors could occur as a result of people attenuating their belief for the omitted item while maintaining a strong recollection. Previous research has linked confidence with people's decisions to report or withhold, or omit, recollections. Koriat and Goldsmith (1996) demonstrated that remembered information can be either volunteered or withheld depending upon the confidence with which the remembered information was held. If information is remembered with a high degree of confidence, it is more likely to be reported than if the information is remembered with low confidence. Scoboria, Talarico and Pascal (2015) have drawn parallels between belief and confidence in relation to Koriat and Goldsmith's model. If indeed belief and confidence are similar, lower belief ratings should also result in people withholding memories.

In the experiments reported here, we attempted to simultaneously elicit nonbelieved memories and omission errors. Whereas previous research has demonstrated that omission errors occur following misleading post-event information (Wright et al., 2001) or that nonbelieved memories occur following challenges to recollections (Clark et al., 2012; Mazzoni et al., 2014; Otgaar et al., 2013), we sought to examine whether both nonbelieved memories and omission errors co-occur. That is, omission errors are the result of items being recollected, but not reported due to attenuated belief.

In our first experiment, participants were presented with four scenes showing a collection of household items at Time 1. After recalling as many items as they could from each scene, participants were re-presented with the scenes again (Time 2). However, for two of the scenes presented at Time 2, one item had been withheld from the scene. Participants then recalled as many items as they could from the scenes presented at Time 1. In Experiment 2, participants saw only two scenes. Instead of re-presenting the scenes to participants, after the first recall, the experimenter read aloud the items the participant had recalled for each scene. For each scene, the experimenter withheld one of the items recalled by the participant. For one scene, a commonly reported (high frequency) item was withheld, and for the other scene a less commonly reported (low frequency) item was withheld. Participants were then asked to recall all of the items they could from the scenes.

In both experiments, participants provided belief and memory ratings for a number of items, including withheld items and non-presented filler items. Finally, participants completed a recognition task whereby they were presented with individual items from the original scenes or non-presented filler items and asked whether they recognised the item as one of the items from the original scene.

Based on previous research (Wright et al., 2001), we hypothesised that participants would omit the withheld items from subsequent recall and recognition tests. Since research has shown that disconfirmatory evidence is a commonly reported reason for people to attenuate their belief (Mazzoni et al., 2010; Scoboria, Boucher & Mazzoni,

2014) we also predicted that our manipulation would cause participants to provide lower belief ratings for the withheld items compared with control items. We, however, did not predict any difference in recollection ratings for the withheld and control items. Thus we predicted that omission errors would occur when participants' belief for the withheld item had been attenuated.

## EXPERIMENT 1

### METHOD

#### *Participants and Design*

Forty-three psychology undergraduate students (31 female) aged 18 to 23 years ( $M = 19.05$ ,  $SD = .97$ ) were recruited via the departmental research participation pool and received course credit for their participation. All participants were presented with the same scenes and therefore this experiment involved a within-subject design. The independent variable was the withheld items. The dependent variables were; recall performance, belief and recollection ratings and recognition performance.

#### *Material*

**Stimuli.** Four photographic scenes were used in the current experiment (see Figure 4), each showing a collection of household items (number of items per scene,  $M = 18.75$ ,  $SD = 2.22$ ) from four categories; kitchen items, food and drink items, bathroom items and office items. We created two sets of scenes. Set 1 (presented at Time 1) contained the four scenes depicted in colour. Set 2 (presented at Time 2) were black and white versions of the scenes used in Set 1 and excluded some withheld items (see below). We decided to present Set 2 in black and white so that participants were able to distinguish between Set 1 and Set 2. This distinction was important for the second recall test (see below).

**Withheld and control items.** At Time 2, participants saw the Set 2 scenes. For two scenes in Set 2, one item from the scene had been withheld. Through pilot testing, we identified the two most frequently reported items for each scene. Participants in the pilot test ( $N = 11$ ) saw each of the scenes before completing a free recall task for each scene. We selected the two most commonly reported items from each scene to be used as the withheld items. These items were: for the bathroom scene, a can of deodorant and a can of shaving foam; for the kitchen scene, a fork and a chef knife; for the office

scene<sup>2</sup>, a pen and a pair of glasses; for the food and drink scene, a banana and a bottle of juice. On average, participants in the pilot test reported 5.36 of these eight items (SD = 1.43). Each of these pairs of items was used in the current experiment as either the withheld or the control item. For example, when the pen was the withheld item, the pair of glasses served as a control item.



**Figure 4.** The four scenes used in Experiment 1.

**Belief and Memory Tasks.** Participants rated both belief and memory on separate tasks. Both tasks contained 28 items consisting of four items which had been present in Set 1 and Set 2 (including the control item), the withheld item and two filler items which had not been present in either set of scenes. For belief, participants were asked to rate the strength of their belief that each of them items has been present in the first set of scenes. Belief was rated on an 8-point scale (1 = no belief / 8 = strong belief). For memory, participants were asked to rate each item for the strength of their memory for the item being present in the first set of scenes. To help participants understand the distinction between belief and memory, at the beginning of each task there was an example. For belief, the example explained that it is possible to believe an event occurred without necessarily having a memory. For memory, the example explained that it is possible to remember an event without necessarily believing the event occurred.

<sup>2</sup> For the office scene, a computer was the most frequently reported item. However, we considered this item too central to the scene to be used as a withheld or control item. We therefore used the next most frequency reported item.

Previous research has also provided participants with similar examples (Clark et al., 2012; Mazzoni et al., 2014).

### *Procedure*

Participants were informed that they would see a series of scenes (Set 1), and were instructed to view each scene carefully as their memory for the items within the scenes would be tested later. Before each scene was presented to participants, a title (either “Kitchen”, “Food & Drink”, “Bathroom” or “Office”) appeared on screen for 5 seconds. The stimulus scene then appeared on screen for 15 seconds followed by a blank screen for 5 seconds. The order of presentation of the stimulus scenes was counterbalanced.

Participants then completed a four-minute filler task before being given the first recall task – Recall 1. The recall task was completed using a booklet containing four pages. On the top of each page was the title of each of the scenes (e.g., Kitchen). For each scene, participants were instructed to write down all of the items they could remember from the scene, and that if they could not name the item, they could instead describe the item, i.e. the shape, colour or its use. There was no time limit to complete the recall test.

Participants were then informed that we were interested in the effect of repeated exposure to the same stimuli and that they were going to see the same scenes again. Participants were presented with the Set 2 scenes. Before each scene was presented to participants, a title (either “Kitchen”, “Food & Drink”, “Bathroom” or “Office”) appeared on screen for 5 seconds. The stimulus scene then appeared on screen for 15 seconds followed by a blank screen for 5 seconds.

After another four-minute filler task, participants were given the second recall task – Recall 2. This test was similar to that the first test but the experimenter made it clear that participants should only report items they remembered from the first scenes presented to them at Time 1 (Set 1). To ensure participants were recalling items from Set 1, we asked participants to report both the item and the colour of the item. There was no time limit for this task.

Next, participants completed the belief and memory rating tasks. All participants completed the belief ratings task before completing the memory rating task. Previous research (Clark et al., 2012; Mazzoni et al., 2014) also used separate belief and memory rating tasks to avoid anchoring effects.

Finally, participants completed a recognition and source monitoring task. For the same 28 items rated in the belief and memory task, participants saw an image of each item individually, and were instructed to indicate whether they recognised the item as presented in any of the scenes they had been presented with during the experiment by pressing either ‘Y’ (Yes) or ‘N’ (No) on the keyboard. Then they had to indicate if they recognised the item from only the scenes presented first, from only the scenes presented second, from both sets of scenes or that they did not recognise the item. Partici-

pants responded using the number pad, responding to a corresponding number which was presented next to each option on the screen. If participants indicated that they recognised the item as present in the first set of scenes only, the second set of scenes only or both sets of scenes, they were then asked to indicate which scene they recognised the item from. There was no time limit for this task.

## RESULTS AND DISCUSSION

### *Coding*

Participants' recall at both Recall 1 and Recall 2 was coded for correct items (correctly reporting an item from the scene) and intrusion errors (reporting an item not present in the scene). Using the recall data from Recall 1 and Recall 2, each recollection for the withheld and control items was coded into four categories. An item was coded 'remembered' if it was reported at both Recall 1 and Recall 2, as 'omitted' if it was reported at Recall 1 but was omitted at Recall 2, as 'new' if it was not reported in Recall 1 but then was reported in Recall 2, and finally, as 'never' if it was not reported at either Recall 1 or Recall 2.

To describe the data and make contrasts, we report 95% confidence intervals for means (Cumming, 2013). All confidence intervals are based on 1,000 bootstrapped samples unless otherwise indicated. Where assumptions were violated, we report the alternative statistics.

### *Recall Performance*

Participants recalled statistically more correct items at Recall 2 ( $M = 8.39$ ,  $SD = .280$ , 95% CI [6.63, 9.27]) than at Recall 1 ( $M = 7.10$ ,  $SD = 1.64$ , 95% CI [6.63, 7.62]),  $t(42) = -4.00$ ,  $p < .001$ ,  $M_{diff} = -1.28$ , 95% CI [-1.90, -.62]. Intrusions— items recalled, but which were not present in the scenes - were reported less frequently at Recall 2 ( $M = .14$ ,  $SD = .23$ , 95% CI [.08, .22]) than at Recall 1 ( $M = .55$ ,  $SD = .52$ , 95% CI [.40, .71]),  $t(42) = 6.36$ ,  $p < .001$ ,  $M_{diff} = .41$ , 95% CI [.28, .55]. These findings suggest that re-presenting participants with the stimuli provided participants with an opportunity to correct erroneous items recalled, and also to learn new items which had not been recalled at Recall 1.

### *Omission Errors*

Table 2 shows the frequency of each type of recollection by item (withheld and control). Omission errors for withheld ( $M = 0.42$ ,  $SD = 0.54$ , 95% CI [0.26, 0.60]) and control ( $M = 0.58$ ,  $SD = 0.66$ , 95% CI [0.40, 0.79]) items was not significantly different,  $t(42) = 1.31$ ,  $p = .197$ , 95% CI [-0.41, 0.09]. Reporting of withheld ( $M = 0.65$ ,  $SD = 0.69$ , 95% CI [0.47,



0.86]) and control ( $M = 0.72$ ,  $SD = 0.70$ , 95% CI [0.51, 0.93]) items was not significantly different,  $t(42) = 0.46$ ,  $p = .645$ , 95% CI [-0.37, 0.23]. This finding does not support our hypothesis that withheld items would be omitted more frequently than control items. Instead, this finding suggests that both withheld items and control items were reported in similar ways. Unlike in previous research (Merckelbach et al., 2007; Wright et al., 2001), looking at the data in Table 2 shows that the control items were omitted more frequently than the withheld items.

**Table 2.** The frequency of remembered, omitted, new and never reported items for the withheld and control items.

	Item			
	Withheld		Control	
Outcome	Frequency	%	Frequency	%
Remembered	28	32.56	31	36.05
Omitted	18	20.93	25	29.07
New	10	11.63	6	6.98
Never	30	34.88	24	27.91

### *Belief and Memory Ratings*

Table 3 shows the belief and memory ratings for both the withheld and control items by memory type. To examine whether belief and memory ratings differed across memory types, we computed four one-way ANOVAs, one for each of the withheld and control items. Due to the low frequency of 'new' items, planned contrasts did not include this outcome. The one-way ANOVA for the first withheld item revealed that belief ratings were not different between the memory types,  $F(3, 39) = 2.52$ ,  $p = .072$ ,  $\eta^2 = 0.16$ . For memory ratings there was a significant effect for memory type,  $F(3, 39) = 3.24$ ,  $p = .032$ ,  $\eta^2 = .20$ . Planned contrasts revealed that memory ratings for remembered items were significantly higher than items which were never reported,  $t(39) = 2.83$ ,  $p = .007$ ,  $M_{diff} = 2.93$ , 95% CI [.90, 4.59]. Remembered items were not rated significantly differently from omitted items,  $t(39) = 1.20$ ,  $p = .237$ ,  $M_{diff} = 1.32$ , 95% CI [-1.00, 3.68], and omitted items were not rated significantly differently from never reported items,  $t(39) = 1.59$ ,  $p = .120$ ,  $M_{diff} = 1.61$ , 95% CI [-.45, 3.67]. For the second withheld item, the one-way ANOVA revealed no effect for belief, Welch's  $F(3, 15.07) = 0.46$ ,  $p = .711$ ,  $\eta^2 = .03$ , and no effect for memory,  $F(3, 39) = 0.11$ ,  $p = .953$ ,  $\eta^2 = .01$ .

For the first control item, for belief,  $F(2, 40) = 1.20$ ,  $p = .313$ ,  $\eta^2 = .06$ , and memory, Welch's  $F(2, 25.14) = 2.18$ ,  $p = .134$ ,  $\eta^2 = .07$ , there was no effect for memory type. For the second control item, for belief, there was a significant effect for memory type, Welch's  $F(3, 13.60) = 6.94$ ,  $p = .005$ ,  $\eta^2 = .52$ . Planned contrasts reveal that Never reported items were rated significantly lower than both remembered items,  $t(10.21) = 4.38$ ,  $p = .001$ ,  $M_{diff} = 3.96$ , 95% CI [2.37, 5.55], and omitted items,  $t(12.38) = 3.73$ ,  $p =$

.003,  $M_{diff} = 3.55$ , 95% CI [1.56, 5.53]. Belief ratings between remembered and omitted items did not differ  $t(11.71) = 1.27$ ,  $p = .230$ ,  $M_{diff} = .41$ , 95% CI [-.18, 1.00]. For memory ratings, there was a significant effect for memory type, Welch's  $F(3, 13.28) = 8.51$ ,  $p = .002$ ,  $\eta^2 = .46$ . Planned contrasts reveal that never reported items were rated significantly lower than both remembered items,  $t(10.60) = 4.92$ ,  $p = .001$ ,  $M_{diff} = 4.16$ , 95% CI [2.66, 5.67], and omitted items,  $t(17.37) = 3.54$ ,  $p = .002$ ,  $M_{diff} = 3.55$ , 95% CI [1.46, 5.63]. Memory ratings between remembered and omitted items did not differ  $t(11.38) = 1.08$ ,  $p = .302$ ,  $M_{diff} = .62$ , 95% CI [-.41, 1.65].

**Table 3.** Mean (SD), and 95% Confidence Intervals (CI) for belief and memory ratings for remembered, omitted and never reported memories by item.

Item	Outcome	Belief		Memory	
		<i>M</i> (SD)	95% CI	<i>M</i> (SD)	95% CI
Withheld 1	Remembered	6.08 (2.54)	[4.47, 7.70]	6.17 (2.79)	[4.39, 7.94]
	Omitted	5.46 (2.67)	[3.85, 7.07]	4.85 (3.13)	[2.95, 6.74]
	Never	3.82 (2.84)	[2.55, 5.10]	3.24 (2.39)	[2.01, 4.46]
	Total	4.98 (2.68)	[4.14, 5.81]	4.57 (2.95)	[3.69, 5.40]
Withheld 2	Remembered	5.63 (2.68)	[4.20, 7.05]	5.38 (2.58)	[4.00, 6.75]
	Omitted	6.20 (2.49)	[3.11, 9.29]	5.80 (2.49)	[2.71, 8.89]
	Never	5.00 (3.39)	[2.95, 7.05]	5.08 (3.23)	[3.13, 7.03]
	Total	5.47 (2.89)	[4.53, 6.41]	5.32 (2.76)	[4.38, 6.21]
Control 1	Remembered	5.00 (3.06)	[3.37, 6.63]	5.56 (2.99)	[3.97, 7.15]
	Omitted	5.79 (2.49)	[4.35, 7.22]	5.64 (2.71)	[4.08, 7.21]
	Never	6.54 (2.33)	[5.13, 7.95]	7.00 (1.47)	[6.11, 7.89]
	Total	5.72 (2.68)	[4.91, 6.51]	6.02 (2.55)	[5.26, 6.77]
Control 2	Remembered	7.87 (.35)	[7.67, 8.06]	7.80 (.56)	[7.49, 8.11]
	Omitted	7.45 (1.04)	[6.76, 8.15]	7.18 1(.83)	[5.95, 8.41]
	Never	3.91 (2.98)	[1.91, 5.91]	3.64 2(.77)	[1.78, 5.50]
	Total	6.57 (2.43)	[5.78, 7.30]	6.38 (2.55)	[5.62, 7.16]

Taken together, the results from the belief and memory ratings in this experiment suggest that our manipulation did not have an effect on participants' belief ratings for the withheld items as predicted. Instead, omitted items received similar belief and recollection ratings to remembered items.

### *Recognition and Source Monitoring*

For the recognition data, we examined hit rates for control and omitted items. The hit rate for the first withheld item was .67, and .95 for the first control item, a significant difference,  $t(42) = -3.63$ ,  $p = .001$ ,  $M_{diff} = -.28$ , 95% CI [-.43, -.12]. For the second withheld item the hit rate was .74, and .91 for the second control item,  $t(42) = -2.00$ ,  $p =$

.051,  $M_{diff} = -.16$ , 95% CI [-.32, .00]. These results showed that our manipulation may have impaired participants' ability to recognise the withheld item.

With the source monitoring data, we examined whether participants correctly attributed the control items to being present in both sets of scenes and the withheld items to being only in the first set of scenes. Our data suggest that, on the whole, control items were more likely to be attributed to the correct source. For the first withheld and control items, approximately one third of withheld items (.33) and almost half of control items were attributed to the correct source (.49),  $t(42) = -1.64$ ,  $p = .109$ ,  $M_{diff} = -.16$ , 95% CI [-.36, .04]. For the second withheld and control items, the proportion of withheld items that were attributed to the correct source (.23) was significantly lower than source judgements for control items (.65),  $t(42) = -4.38$ ,  $p < .001$ ,  $M_{diff} = .42$ , 95% CI [-.61, -.23]. Of the 37 incorrect source judgements of control items, participants most frequently attributed them to only Time 1 (45.95%) or only Time 2 (37.84%), with fewer attributions to neither scene (16.22%). For withheld items, 62 errors were made with participants reporting the items as being in both scenes at Time 1 and 2 (61.67%) or neither scenes (37.10%) but less frequently to only Time 2 (3.23%).

To summarize, the results of our experiment do not support our hypotheses. Withholding a previously presented item did not result in omission errors for the withheld items (20.93%) above the frequency of omission errors for the control items (29.07%) in the free recall task. Some support for our expectation was found in that we did find that participants were less likely to recognise the withheld item, a finding which was significant for the first withheld item, but not quite significant for the second withheld item. Because participants saw the withheld items once, but the control items twice, one explanation for our finding could be that the memory trace was much stronger for the control item than the withheld items (e.g., Ayers & Reader, 1998).

The results of Experiment 1 suggest that the manipulation was too subtle to create a considerable amount of omission errors for the withheld items compared with the control items. Looking at the free recall results, participants may have used the representation of the scenes at Time 2 as a way to improve their correct recall and decrease their errors. Indeed, we observed that correct recall increased and intrusion errors decreased at Recall 2 (cf. Recall 1). Further support for the idea that our manipulation was too subtle comes from the source monitoring data which shows participants most frequently attributed withheld items as being present at Time 1 and Time 2, or as not being present at either Time 1 or Time 2. This finding suggests that participants either did not notice the withheld item had been withheld, or that participants had not noticed the withheld item at Time 1.

In Experiment 2 we made two changes to the methodology so that the withheld items were more distinctive. In Experiment 2, rather than re-presenting participants with the scenes again at Time 2, the experimenter read back to the participants the items they had recalled at Recall 1, but omitted the withheld items. We also manipulated which items were withheld. Some of the items in the scenes are recalled by partici-

pants more often than others. In Experiment 2, we consider the idea that items which are less frequently reported might be omitted more readily. The discrepancy detection principal (Tousignant, Hall & Loftus, 1986) suggests that misinformation is more likely to be accepted with the discrepancy between the original material and the misinformation. For example, research has found it relatively easy to misinform participants about the type of sign they saw in a previously presented scene. Participants who saw a stop sign can be misled to thinking the sign was actually a yield sign. Also, the trace strength hypothesis (Pezdek & Roe, 1995) argues that strong memory traces are less vulnerable to misleading information than weak memory traces. We therefore predicted that participants would be more likely to omit an item which is more salient in these scenes. In Experiment 2, the withheld items were a commonly reported item (high frequency) and a less commonly reported (low-frequency).

## EXPERIMENT 2

### METHOD

#### *Participants and Design*

Participants were recruited by sending an email to a database of people who were willing to be contacted to participate in research at the University of Portsmouth. We recruited 43 participants (33 female) aged 18 to 60 ( $M = 34.79$ ,  $SD = 12.56$ ). Participants received £7 for taking part. Eight participants were excluded from the analysis, one due to experimenter error, two because they recalled too few items, and five participants because they realised the manipulation. The remaining 35 participants (28 female) were aged 18 to 60 years ( $M = 36.14$ ,  $SD = 12.57$ ). This experiment involved a within-subject design with all participants being presented with the same scenes. The independent variable was whether withheld items were withheld or not. The dependent variables were recall performance, belief and recollection ratings, recognition performance and confidence ratings.

#### *Material*

**Stimulus.** Two scenes were used in the current experiment, one showing a collection of kitchen items (e.g., a plate, a bowl, a fork and a spoon) and one showing a collection of office items (e.g. a computer, a pen, a notebook and a stapler). In the kitchen scene there was a total of 20 items, and 18 in the study scene. To control for scene effects, the presentation order of these scenes was counterbalanced.

**Withheld and control items.** In Experiment 2, participants were exposed to two withheld items, one for each scene. One of these items was a high frequency item, and the other item was a low frequency item. In previous research, 68 participants had seen the two scenes used in the current research. For each of the 68 participants, we noted which specific items each participant had reported for each scene. We then took the total for each item (i.e., 5 participants mentioned item 'X', 10 participants mentioned items 'Y', 25 participants mentioned item 'Z'), and calculated the mean for that scene (e.g., 13.33). Any items which received a frequency above this mean were considered a high frequency item and anything below mean was considered a low frequency item.

For each of the withheld items, we selected a similar item (based on the frequency of reporting) to be the control items. We choose the item with the closest frequency ratings to the withheld item.

**Belief/Memory Task.** We used the same belief and memory rating task as in Experiment 1. However, in Experiment 2 we were not able to control which item would be the withheld item because it depended on which items the participants recalled. Therefore, we included all items from both scenes as well as six plausible lures for each scene. In both the belief and memory rating task, there was a total of 50 items, comprised of the 20 items from the kitchen scene and six lure items and 18 items from the study scene and six lure items.

As in Experiment 1, each item on both the belief and memory rating task was presented in a random order, but unlike in Experiment 1, in Experiment 2 we counterbalanced the order in which participants completed the belief and memory ratings tasks so that half of the participants completed the belief ratings task first, then the memory ratings task and vice versa.

In experiment 2 we collected belief and memory ratings using an 11-point scale. We changed the scale from an 8-point scale in Experiment 1 to an 11-point scale in Experiment 2 because in Experiment 2 we also collected confidence ratings (see below). Measuring belief, memory and confidence on similar scales would allow for more precise comparisons between these measures. The scale for the belief and memory rating tasks was 0 (no belief/memory) to 10 (strong belief/memory).

**Recognition task.** The recognition task used the same 50 items used in the belief and memory ratings tasks. Here participants were presented with an image of each item. Participants were required to indicate if they recognised the item by responding with yes (press 'Y') or no (press 'N') on the keyboard. Participants were then asked to rate how confident they were in their recognition response. Confidence was rated using an 11-point scale (0 = not confident to 100 = very confident)

### *Procedure*

Participants were informed that in this experiment they would see a series of scenes containing a collection of items, preceded by a title for the scene and that they were to

remember as many items from each scene as possible. They were also informed that a memory test would follow. The presentation was presented via a computer. Participants saw the title of the scene for 5 seconds, then the scene for 15 seconds. Between each scene, there was a 5-second pause before the next title and then scene.

After a four-minute filler task, participants were given the first recall task. The recall task was completed using a booklet which contained on each page a title from each of the scenes. Participants were instructed to write down everything they remembered from the scene, and that if they could not name the item, they could instead describe the item, i.e. the shape, colour or its use. There was no time limit to complete the recall test.

After completing the free recall task, participants were given another four-minute filler task. Participants were then informed that the researcher was going to read each of the items they had recalled from each of the scenes back to them. The researcher then read the items at an approximate rate of one word per second. The researcher read the items from the first scene participants had seen first, however, the items were not read in the same order as they had been written by the participant. All items were read from the lists except the withheld item. After another four-minute filler task participants were given the second recall task. This test was identical to that first test. There was no time limit for this part of the experiment.

After completing the free recall task, participants completed the belief and memory ratings tasks. For each item, participants were instructed to report the strength of their belief/memory for seeing each of the items in the scenes. Participants provided responses to each item by indicating the strength of their belief/memory using the number-pad on the keyboard.

Finally, participants completed the recognition task. Each item was presented on the computer screen as a single image. Participants were instructed to indicate if they recognised the item as presented in any of the by pressing either 'y' (Yes) or 'n' (No) on the keyboard. Participants then indicated their confidence ratings.

## RESULTS AND DISCUSSION

**Coding** Participants recall at both Recall 1 and Recall 2 was coded for correct items (correctly reporting an item from the scene) and intrusion errors (reporting an item not present in the scene). Using the recall data from Recall 1 and Recall 2, each recollection for the withheld and control items was coded into four categories. An item was coded 'remembered' if it was reported at both Recall 1 and Recall 2, as 'omitted' if it was reported at Recall 1 but was omitted at Recall 2, as 'new' if it was not reported in Recall 1 but then was reported in Recall 2, and finally, as 'never' if it was not reported at either Recall 1 or Recall 2.

To describe the data and make contrasts, we report 95% confidence intervals for means (Cumming, 2013). All confidence intervals are based on 1,000 bootstrapped samples unless otherwise indicated. Where assumptions were violated, we report the alternative statistics.

### *Recall Performance*

Participants reported a similar number of items at both Recall 1, ( $M = 9.71$ ,  $SD = 1.85$ , 95% CI [9.03, 10.33]) as in Recall 2, ( $M = 9.67$ ,  $SD = 1.78$ , 95% CI [9.02, 10.26]),  $t(32) = .35$ ,  $p = .731$ ,  $M_{diff} = .05$ , 95% CI [-.22, .31]. Participants also made a similar number of intrusion errors across both Recall 1, ( $M = .59$ ,  $SD = .65$ , 95% CI [.38, .83]) and Recall 2, ( $M = .62$ ,  $SD = .61$ , 95% CI [.42, .85]),  $t(32) = -.47$ ,  $p = .645$ ,  $M_{diff} = -.03$ , 95% CI [-.16, .10]. These results show that participants' recall performance remained consistent between both the recall tests with regards to correct recall and intrusion errors.

### *Omission Errors*

Participants reported significantly fewer of the high frequency withheld items ( $M = .85$ ,  $SD = .36$ , 95% CI [.70, .97]) than high frequency control items ( $M = 1.00$ ,  $SD = 0.00$ , 95% CI [1.00, 1.00]),  $t(32) = -2.39$ ,  $p = .023$ ,  $M_{diff} = -.15$ , 95% CI [-.28, -.02]. However, omission of the low frequency withheld items ( $M = .97$ ,  $SD = .17$ , 95% CI [.91, 1.0]) was not significantly different to omission of the low frequency control item, ( $M = .97$ ,  $SD = .17$ , 95% CI [.91, 1.0]),  $t(32) = 0.00$ ,  $p = 1.00$ ,  $M_{diff} = 0.00$ , 95% CI [-.09, .09]. Contrary to our expectation, these results show that our manipulation had a greater effect with regards to high frequency items than low frequency items. Overall, 15% of the high frequency withheld items were, compared with only 3% of the low frequency omitted items.

### *Belief and Memory Ratings*

Belief and memory ratings for the high and low frequency withheld and control items are presented in Table 4. For the high frequency withheld items, there was not a significant effect of whether an item was reported or omitted for either belief ratings  $F(1, 31) = 0.29$ ,  $p = .596$ ,  $\eta^2 = .01$  or memory ratings,  $F(1, 31) = 0.44$ ,  $p = .514$ ,  $\eta^2 = .01$ .

For the high frequency control item, participants reported all of these recollections and so a comparison between reported and omitted items is not required.

For the low frequency withheld items, the effect of whether an item was reported or omitted for belief ratings,  $F(1, 31) = 0.16$ ,  $p = .692$ ,  $\eta^2 = .01$  and memory ratings,  $F(1, 31) = 0.14$ ,  $p = .710$ ,  $\eta^2 = .005$  was not significant. For belief ratings of the low frequency control items, there was a significant effect of whether an item was reported or omitted  $F(1, 31) = 4.49$ ,  $p = 0.042$ ,  $\eta^2 = .13$ , with belief ratings for omitted items being significantly lower than reported items.

For memory ratings, there was also a significant effect of whether an item was reported or omitted,  $F(1, 31) = 8.22$ ,  $p = .007$ ,  $\eta^2 = .21$ , with omitted items being significantly lower than reported items.

### *Recognition and Confidence*

To examine the recognition data, we examined the proportion of participants who correctly recognised the withheld items and compared this to the proportion of participants who correctly recognised the control items. The proportion of participants who recognised the omitted item was .94, compared with .97 of participants recognising the high frequency control item. There was not a significant difference between these proportions,  $t(32) = -.57$ ,  $p = .572$ ,  $M_{diff} = -.03$ , 95% CI  $[-.14, .07]$ .

**Table 4.** Mean (SD), and 95% Confidence Intervals (CI) for belief and memory ratings for the withheld and control items by frequency and report outcome (reported or omitted)

Item	Frequency	Reported/ omitted	<i>n</i>	Belief		Memory	
				M (SD)	95% CI	M (SD)	95% CI
Withheld	High	Reported	28	9.46 (1.37)	[8.89, 9.89]	9.64 (1.19)	[9.10, 9.97]
		Omitted	5	9.80 (.45)	[9.44, 10.00]	10.00, (0.00)	[10.00, 10.00]
	Low	Reported	32	8.69 (3.24)	[7.48, 9.69]	8.92 (2.87)	[7.81, 9.79]
		Omitted	1	10.00 (0.00)	[10.00, 10.00]	10.00 (0.00)	[10.00, 10.00]
Control	High	Reported	32	9.66 (1.23)	[9.19, 10.00]	9.19 (2.87)	[8.16, 9.94]
		Omitted	1	7.00 (.00)	[7.00, 7.00]	2.00 (.00)	[2.00, 2.00]
	Low	Reported	33	9.30 (1.61)	[8.67, 9.79]	9.18 (2.10)	[8.33, 9.79]
		Omitted	0	-	-	-	-

The proportion of participants who correctly recognised the low frequency omitted item was .97, and this was identical to the proportion of participants who correctly recognised the control item, .97. Therefore no statistic is reported for this finding. These findings suggest that our manipulation did not influence omission errors for the withheld items in the recognition memory test.

Participants were confident in their recognition responses for the high frequency withheld items ( $M = 94.55$ ,  $SD = 12.52$ , 95% CI [89.70, 98.48]) and the control item ( $M = 93.94$ ,  $SD = 16.19$ , 95% CI [87.27, 98.48]), and the difference in confidence ratings was not significant,  $t(32) = .17$ ,  $p = .863$ ,  $M_{diff} = .61$ , 95% CI  $[-6.48, 7.69]$ . Confidence for the low frequency omitted item ( $M = 95.45$ ,  $SD = 13.71$ , 95% CI [90.01, 99.39]) was statistically similar to the confidence rating for the control item ( $M = 94.55$ ,  $SD = 17.52$ , 95% CI [87.58, 99.39]),  $t(32) = .62$ ,  $p = .54$ ,  $M_{diff} = .91$ , 95% CI  $[-2.08, 3.90]$ . Confidence in participants' recognition responses overall, was high. When considered with the recognition test results, these findings suggest that participants were highly confident that the high and low frequency withheld item was present in the original scene.



To summarise, in Experiment 2 we found that participants made more omission errors for the high frequency withheld item (cf. a control item) than the low frequency withheld item (cf. a control item) in the free recall memory test. Also, contrary to our expectations, our manipulation did not appear to have had an effect on belief ratings for the withheld items. Finally, participants recognised the withheld items with a high degree of confidence. Taken together, these results did not support our expectations that withholding items would result in participants attenuating their belief that these items had been part of the original scenes. Furthermore, we did not find support for our expectation that withheld items would result in omission errors above the rate of omission errors for the control items.

## GENERAL DISCUSSION

Both experiments reported here examined whether omission errors occurred because participants attenuated their belief for a to-be-remembered item. In two experiments we demonstrated that re-presenting participants with either the original stimuli (Expt. 1) or repeating back to participants the items they had recalled (Expt. 2) with some items withheld, did not result in participants attenuating their belief that they had previously seen these items. Furthermore, we did not find substantial evidence that these items were even omitted (at a higher rate) as predicted from previous research (Wright et al., 2001). In Experiment 1 we found that participants were less likely to recognise the withheld item compared with a control item, but this finding was not replicated in Experiment 2. Below, we discuss how our findings fit with prior findings.

Previous research has found that re-presenting participants with some stimuli, but with some items withheld, resulted in omission errors in recall and recognition memory tests (Wright et al., 2001). There are a number of methodological differences between the research reported here and the research reported by Wright and colleagues which could explain the different pattern of results. Firstly, in the current experiment participants were re-presented with the stimuli only a few minutes after they had seen the stimuli for the first time, whereas participants in the Wright et al. experiment were re-presented with the stimuli when they returned for the second session one week later. Participants are more susceptible to the effect of misleading post-event information after a greater delay (Loftus et al., 1978; Paterson, Kemp & Forgas, 2009). In our experiment, the delay between seeing the original scenes and being re-presented with the scenes was around eight minutes. Future research might find an increased rate of omission errors following a longer delay.

Research examining the factors which make people more vulnerable to the effect of misleading post-event information have documented a discrepancy detection principle (Tousignant et al., 1986). The discrepancy detection principle suggests that misleading post-event information is less likely to mislead participants if there is a greater discrep-

ancy between what the participants originally saw and the misleading post-event information. This principal could explain why some research has found that changing details within a memory report is easier than eliciting omission errors (e.g., Pezdek & Roe, 1997). However, in Experiment 2, we found that participants omitted more of the high frequency withheld items (cf. a control item) than low frequency withheld items (cf. a control item) suggesting that withholding high-frequency items had a greater effect than withholding low-frequency items. One possible explanation for this finding could be that the low-frequency items could be more distinctive. Research has shown that schema-inconsistent items are more distinctive (McDaniel, 1984) and should receive a greater amount of attention at encoding. If indeed the low-frequency items were given more attention, this could explain why low-frequency items were not prone to becoming omission errors. Thus, these items would, according to the discrepancy detection principle, be more difficult to elicit omission errors for.

In both Experiments 1 and 2, we found that our manipulation had no effect on belief ratings. We had predicted that belief ratings would decrease for the withheld items compared with remembered non-withheld items but our data did not support this hypothesis. On reflection, and in light of other recent work by colleagues, it may be the case that the manipulation applied in our experiments was simply too subtle/insubstantial to meaningfully affect belief ratings. For example, recent research has identified different subtypes of nonbelieved memories. Scoboria et al., (in press) identified three subtypes of nonbelieved memories and also examined whether these subtypes were associated with any specific reasons for the participants attenuating their belief. The results showed that both classic and weak nonbelieved memories were most commonly associated with events which had been considered implausible or where the rememberer had received social feedback from someone else telling them that the recollected event had not occurred. Classic nonbelieved memories also occurred when people were unable to obtain evidence to support the occurrence of an event. Finally, weak nonbelieved memories were often found when people found the memory to be inconsistent with their view of another person. These findings show that there are different subtypes of nonbelieved memories and that continued research is needed to examine the factors which influence belief and how different factors could influence belief in different ways.

The fact that our material was themed could have enhanced participants' memories for the items within the scenes. Research has shown that gist memory enhances both false and true memory. Or put another way, gist can inoculate against forgetting. Our scenes were of household items, and the items within the scenes were all associated with things you would expect in, for example, a study (e.g., a computer, a pen, a highlighter). Fuzzy-trace theory (e.g., Brainerd & Reyna, 2002) predicts that gist processing should increase both false and true recall. Gist processing relates to the semantic features of the to-be-remembered stimuli. Indeed, our stimuli had a gist or a theme in which all of the items were semantically related to the theme of the scene. One way

that gist processing could be prevented in such an experiment would be to use unrelated items in a scene. That is, each scene should contain items which are not based on a theme or gist.

In Experiment 1 we found evidence that re-presenting some stimuli, but not others, resulted in omission errors in a recognition memory test for the non-re-presented items. However, in Experiment 2 this effect was not replicated. Given the inconsistency of this finding in the current research, it is difficult to interpret this finding. Previous research also found omission errors occurred in a recognition memory test (Wright et al., 2001). While the results of Experiment 1 do provide some support for the finding by Wright et al. further research is needed to understand how omission errors might occur in recognition memory and the possible consequences that might occur in real world settings such as eyewitness identifications.

In sum, contrary to the speculation of previous research indicating a relationship between nonbelieved memories and omission errors (Mazzoni et al., 2014; Otgaar et al. 2014), we did not find that nonbelieved memories led to increased omission errors in the present experiments. These results suggest that to cause an attention of belief, a more direct and less subtle manipulation may be required. The research presented here demonstrates that further research is needed to understand the effect of re-presenting people with previously encountered stimuli can have on subsequent memory reports.

# Chapter 4

## Experiments 3 and 4

Social challenges to memories results in omission errors and the attenuation of belief and recollection

The experiments presented in Chapter 4 are currently under review as part of a special issue on the theoretical and legal implications of belief and recollection at the journal *Memory*

## OVERVIEW

Researchers have speculated that inducing a nonbelieved memory – an event which is recollected, but for which belief that the event occurred has been attenuated – could be the precursor to making an omission error. Research has also shown that social feedback is the most commonly reported reason for people withdrawing belief in a recollected event. In two experiments, participants' recollections of items (Expt. 3) or actions (Expt. 4) were challenged by either a confederate (Expts. 3 & 4) or by the experimenter (Expt. 4). In Experiment 3, following the challenge made by the confederate, participants were more likely to omit the challenged item, while in Experiment 4, omission errors only occurred when participants were challenged by the experimenter. In both experiments we found nonbelieved memories occurred following social feedback, but these were for both reported and omitted recollections. The current experiments found only weak evidence that nonbelieved memories are precursors to omission errors.

## INTRODUCTION

Receiving social feedback from other people about our memories of the past can reshape how we remember the past (Blank, Walther & Isemann, in press). For example, research has shown that when other people challenge our memories, we oftentimes omit the challenged events from subsequent memory reports (Merckelbach et al., 2007). Recent research on memories where the rememberer has attenuated their belief that the recollected event actually occurred, also called nonbelieved memories (Mazzoni et al., 2010), has also focused on the effects of social feedback (e.g., Mazzoni et al., 2014). Interestingly, a commonly reported reason for people attenuating their belief for a recollected event is social feedback (Scoboria et al., 2015) and social challenges have been found to result in, omission errors (Merckelbach et al., 2007) and the attenuation of belief in a recollected event (e.g., Clark et al., 2012). The current research focuses on the potential relationship between attenuated belief and omission errors following social feedback. Specifically, in two experiments, we examined whether the effects of social feedback on omission errors were associated with the attenuation of belief.

Omission errors have been found to occur following social feedback that challenges someone's memory. Merckelbach et al. (2007) showed participants, who were paired with a confederate, six household scenes (e.g., a kitchen, a bedroom, and a garage). Both the participant and confederate then engaged in collaborative recall, each taking turns to recall items from the scenes. In the 'add condition', the confederate claimed to have seen two false items, while in the 'omit condition', the confederate challenged participants' recollections by denying that they had seen two of the items reported by the participant (referred to as 'negative misinformation'; Mazzoni et al., 2014). In the 'control condition', the confederate did not report or deny any items incorrectly. In a subsequent individual recall phase, participants were asked to recall as many items as they could from each of the scenes they had previously seen. Merckelbach et al. (2007) found that 72% ( $n = 21$ ) of participants in the omit condition omitted at least one of the items challenged by the confederate, compared with 33% ( $n = 10$ ) of participants in the control condition. In the add condition, 52 % ( $n = 16$ ) of participants reported at least one of the false items reported by the confederate, compared with 0% in the control condition. The results of this experiment suggest that when recollections are challenged socially<sup>3</sup>, *omissions from* memory reports are more likely than *additions to* memory reports. What is not yet clear is the mechanism(s) that underlies omission errors.

Interestingly, Merckelbach et al.'s (2007) speculation about their findings describe a mechanism similar to that proposed to be involved in what have been called nonbelieved memories (Mazzoni et al., 2010; Otgaar et al., 2014). Specifically, they argued that participants might have omitted the items challenged by the confederate because

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<sup>3</sup> The challenges can even be quite subtle and still lead participants to alter their memory reports (see Granhag, Strömwall, & Billings, 2003 and Ost, Hogbin & Granhag, 2006 for a replication).

they were '*unsure*' about these items. This suggests the possibility that participants did not omit these items because they experienced difficulty retrieving them from memory, but because they were strategically regulating their memory reports, based on their belief in the accuracy of these items. According to metacognitive theories of memory reporting (e.g., Koriat & Goldsmith, 1996) people strategically regulate their memory reports such that if confidence for a memory is low, and the potential consequences of reporting an incorrect answer are high, a participant would be more likely to withhold their response than when confidence is high. This suggests that omission errors might be characterised more by an attenuation of the belief that the event occurred, than by a lack of recollection. This raises the possibility that the mechanisms driving some omission errors are alike those of driving nonbelieved memories; specifically, a clearly recollected event might not be reported because belief in the occurrence of that event has been undermined through, for example, social feedback.

Researchers have used social feedback, similar to that used by Merckelbach et al. (2007) to elicit nonbelieved memories. For example, Clark et al. (2012) induced false memories for performing simple actions using doctored videos (see also Nash, et al., 2009b). After taking measures of 'recollection' and 'belief' in those false memories, the researchers 'debriefed' participants by telling them that they had watched a doctored video that suggested they had performed two actions, that, in fact, they had not. The results showed that following the 'debriefing,' belief ratings for the false events decreased significantly, while memory ratings did not. In other words, this social feedback significantly decreased participants' belief that the event occurred, without altering their recollection of the event (see Otgaar et al., 2013 for another example using childhood memories in adult and children participants).

Social feedback has also been used to elicit nonbelieved memories for true memories. Using a similar procedure to Clark et al. (2012), Mazzoni et al. (2014) attempted to induce nonbelieved memories for simple actions that had been performed in a laboratory (Mazzoni et al., 2010). During a mock 'debriefing', participants were told that they had not performed two of the actions they had in fact performed and that the researchers had, in fact, used doctored video evidence to induce a 'false memory' for those actions. Mirroring the findings of Clark et al. (2012) with false events, Mazzoni et al. (2014) found that belief ratings for 'debriefed' actions decreased significantly, while memory ratings did not. This experiment extended previous research showing that nonbelieved memories could also be created when it was suggested to participants that an experienced event had not occurred (see also Otgaar et al., 2016).

Researchers have also found that naturally occurring nonbelieved memories are often reported to have occurred following social feedback. For example, Mazzoni et al. (2010) found that in a sample of 98 participants reporting to have a nonbelieved memory, 56% of them said that they had attenuated their belief following social feedback. Scoboria et al. (2015) examined 374 cases of nonbelieved memories and also found that belief has been attenuated following social feedback in 52.8% of the cases.

Thus there are clear indications that the attenuation of belief can occur following social feedback which challenges peoples' memories of the past.

In sum, the limited research to date has shown that social challenges can result in both omission errors as well as nonbelieved memories, and a common factor is social feedback. Despite the similarities, research concerning omission errors has not obtained memory and belief ratings for the challenged events, so to date, the research is silent on the relationship between omission errors and the attenuation of belief. The research presented here is the first to specifically examine whether presenting participants with social feedback in the form of negative misinformation results in the elicitation of omission errors which are characterised by the attenuation of belief.

Here, we examined whether socially challenging recollections resulted in omission errors and whether these errors were the result of attenuated belief. Specifically, in Experiment 3, participants, together with a confederate, saw a series of scenes. In a collaborative recall task, participants received negative misinformation from the confederate suggesting that certain items were not present, while in the control condition no negative misinformation was provided. In Experiment 4, participants performed actions together with a confederate. During a collaborative recall task, participants either received negative misinformation from the confederate, from the experimenter or were not exposed to negative misinformation.

Based on the findings from Merckelbach et al. (2007), we predicted that socially administered negative misinformation provided by a confederate (Experiment 3) would result in participants omitting the challenged items in a subsequent free recall task. In Experiment 4 we introduced a third condition in which the experimenter provided negative misinformation. We expected the experimenter to be perceived as more credible, and therefore omission errors to occur more frequently when the experimenter was the source of negative misinformation as opposed to the confederate. We further predicted that, if social feedback is indeed a key factor associated with the attenuation of belief (e.g., Scoboria et al., 2015), this socially administered negative misinformation would cause participants to attenuate their belief for the recollected information. Thus we expected omitted items to receive lower belief ratings compared with the memory ratings.



## EXPERIMENT 3

### METHOD

#### *Participants and design.*

Seventy-two participants (54 female) were recruited via advertisements to staff and students at the University of Portsmouth. Ages ranged from 16 to 63 years ( $M_{age} = 29.85$ ,  $SD = 10.98$ ). Data for 11 participants were excluded because they were unable to recall six items in the collaborative recall task (see below). Data for an additional participant was excluded because they failed to understand the instructions. The final analysis is based on 60 participants, (48 female, 12 male) aged 19 to 63 years ( $M_{age} = 30.23$ ,  $SD = 11.43$ ). Participants received £5 for taking part in the experiment.

The current experiment used a between-subjects design and participants were randomly assigned to one of the two conditions, confederate-challenged ( $n = 30$ ) and control ( $n = 30$ ). Two female confederates were employed in this experiment.

#### *Material and Procedure.*

On arrival for the experimental session, the confederate and participant were introduced to each other as co-participants (i.e., the participant was led to believe that the confederate was another participant who had signed up for the same experimental session). The participant and confederate were seated in front of a computer screen and were informed that they were going to view some scenes. They were instructed to view each scene carefully as their memory for the scenes would be tested later. Two photographic scenes (used in Expts. 1 & 2) were presented to participants, each showing a collection of items from a kitchen (20 items including, e.g., fork, plate, and whisk) and an office (18 items including, e.g., computer, pen, and stapler). The items in these scenes were arranged on a white background. Before the stimulus scene appeared, a title (either “Kitchen” or “Office”) appeared on screen for 5 seconds. The stimulus scene (either kitchen or office scene) appeared on screen for 15 seconds followed by a blank screen for 5 seconds. The order of presentation of the stimulus scenes was counterbalanced across participants.

After participants had viewed both scenes they completed a four-minute nonverbal number search filler task after which they engaged in collaborative recall. For each scene that had been presented, the confederate and participant were asked to take turns to verbally recall one item from the scene, continuing to alternate until each had recalled six items from this scene. In the confederate-challenged condition negative misinformation was provided by the confederate for the sixth item in one scene saying “The [name of item] that you mentioned was certainly not present in this picture; oth-

erwise I would have noticed that". In the control condition, the confederate did not deny seeing any items. For one scene, the participant was first to recall an item, and for the other scene, the confederate went first. Order of responding was counterbalanced across the two scenes.

The participant then worked on a 10-min filler task in a separate room to the confederate, before completing an individual free recall task. In the free recall task, participants were presented with a blank page containing just the title of the first scene they had seen and asked to write down everything they could remember from that scene. Participants then did the same for the other scene. There was no time limit for this task.

Participants then provided belief and memory ratings for all 24 items generated by themselves and the confederate in the collaborative recall task. These ratings were provided on an 11-point scale (0 = no belief/memory, 10 = strong belief/memory). Belief and memory were rated separately; half of the participants rated belief first, and the other half rated memory first. To help participants understand the distinction between belief and memory, at the beginning of each task there was an example. For belief, the example explained that it is possible to believe an event occurred without necessarily having a memory. For memory, the example explained that it is possible to remember an event without necessarily believing the event occurred. Previous research has also provided participants with similar examples (Clark et al., 2012; Mazzoni et al., 2014).

## RESULTS AND DISCUSSION

### *Coding*

Accuracy in the free recall task was coded by counting the number of correctly recalled items for each scene. We also coded intrusion errors, where participants had recalled items that were not present in either of the scenes. The items challenged by the confederate were coded as 'reported' if they were recalled, or 'omitted' if they were not reported in the free recall task. As a comparable control item, participants from the confederate-challenged condition were paired with a participant from the control condition and the sixth item from the same scene was used as a control item.

To describe the data and make contrasts, we report 95% confidence intervals for means (Cumming, 2013). All confidence intervals are based on 1,000 bootstrapped samples unless otherwise indicated.

### *Recall Performance*

Recall of correct items in the free recall task was almost identical between the confederate-challenged ( $M = 10.42$ ,  $SD = 2.06$ , 95% CI [9.72, 11.18]) and control conditions ( $M = 10.42$ ,  $SD = 1.92$ , 95% CI [9.67, 11.07]),  $t(58) < 1$ ,  $p = 1.00$ ,  $M_{diff} = 0.00$ , 95% CI [-1.03,

1.03]. For intrusion errors, there was no difference between participants in the confederate-challenged condition ( $M = 0.48$ ,  $SD = 0.64$ , 95% CI [.28, 0.70]) and participants in the control condition, ( $M = .57$ ,  $SD = 0.50$ , 95% CI [0.40, 0.77]);  $t(58) = .56$ ,  $p = .576$ ,  $M_{diff} = 0.08$ , 95% CI [-0.21, 0.38].

### *Omission Errors*

In the individual recall task, 11 (36.67%) participants in the confederate-challenged condition omitted the item challenged by the confederate, compared with only four participants (13.30%) in the control condition. A 2 (condition: confederate-challenged vs. control) x 2 (report option: reported vs. omitted) Chi-square test showed a significant association between condition and report option,  $X^2(1, N = 60) = 4.36$ ,  $p = .037$ ,  $\phi = .27$ , odds ratio = 3.76, 95% CI [1.04, 13.65]. This result supported our prediction that participants who had their memories challenged by the confederate would be more likely to omit these items.

### *Belief and Memory Ratings*

Overall, participants in the confederate-challenged condition rated the challenged items lower for belief ( $M = 7.27$ ,  $SD = 3.74$ , 95% CI [5.86, 8.51]) than the control items reported in the control condition ( $M = 8.90$ ,  $SD = 1.86$ , 95% CI [8.23, 9.52]),  $t(42.56) = 2.14$ ,  $p = .038$ ,  $M_{diff} = 1.63$ , 95% CI [0.09, 3.17]. Participants in the confederate-challenge condition also rated challenged items lower for memory ( $M = 7.53$ ,  $SD = 3.44$ , 95% CI [6.23, 8.73]) than the control items in the control condition ( $M = 8.13$ ,  $SD = 3.15$ , 95% CI [6.92, 9.17]), however, this was not a statistically significant difference,  $t(58) = .71$ ,  $p = .484$ ,  $M_{diff} = 0.60$ , 95% CI [-1.10, 2.30]. Items challenged by the confederate received lower belief and memory ratings overall.

We were interested in belief and memory ratings for reported and omitted items. Table 5 shows the mean belief and memory ratings for reported and omitted items by condition. A 2 (condition: confederate-challenged vs. control) x 2 (report option: reported vs. omitted) mixed ANOVA for belief ratings revealed a statistically significant effect of condition,  $F(1,56) = 4.43$ ,  $p = .04$ ,  $\eta_p^2 = .07$ , report option  $F(1,56) = 20.94$ ,  $p < .001$ ,  $\eta_p^2 = .27$ , and a significant interaction  $F(1,56) = 4.45$ ,  $p = .039$ ,  $\eta_p^2 = .07$ . These findings show that participants in the confederate-challenged condition (cf. control) reported lower belief ratings for the challenged items, especially when these items were omitted. This finding aligns well with Scoboria et al.'s (2015) finding that social feedback about the occurrence of our recollections is a common reason reported for withdrawing belief in occurrence of an event.

For memory ratings, a 2 (condition: confederate-challenged vs. control) x 2 (report option: reported vs. omitted) mixed ANOVA revealed no significant interaction  $F(1, 56)$

$= 1.31, p = .257, \eta_p^2 = .02$ . There was not a significant main effect of condition,  $F(1, 56) = 0.07, p = .796, \eta_p^2 = .001$ , but there was a statistically significant main effect for report option,  $F(1, 56) = 17.06, p < .001, \eta_p^2 = .23$ . Omitted items received lower memory ratings in the confederate-challenged condition compared with the control condition. Taken together, the belief and memory data suggest that our manipulation caused participants to rate challenged items lower on belief than memory compared with control items.

**Table 5.** Mean (SD), and 95% Confidence Intervals (CI) for Belief and Memory Ratings According to Condition and Report Outcome for challenged and control items

Condition	Belief				Memory			
	Reported		Omitted		Reported		Omitted	
	<i>M</i> (SD)	95% CI	<i>M</i> (SD)	95% CI	<i>M</i> (SD)	95% CI	<i>M</i> (SD)	95% CI
Control	9.15 (1.78)	[8.43, 9.87]	7.25 (1.71)	[4.53, 9.97]	8.50 (3.08)	[7.26, 9.74]	5.75 (2.87)	[1.18, 10.32]
Confederate-challenged	9.16 (2.06)	[8.16, 10.15]	4.00 (3.79)	[1.45, 6.55]	9.32 (1.60)	[8.54, 10.09]	4.45 (3.64)	[2.01, 6.90]

In sum, participants who received negative misinformation from a confederate were less likely to report these items. Also, participants who had their recollections challenged also provided lower belief ratings for the challenged items. We did, however, also find that omitted items were rated lower for memory strength, but this was for omitted items across all conditions. The results of Experiments 3 therefore show that social challenges result in both omission errors and the attenuation of belief ratings.

In Experiment 4, we attempted to replicate the findings from Experiment 3 with more personally relevant stimuli and also by changing the source of the social feedback to a potentially more credible source. In Experiment 4, the stimuli used were self-performed actions. Much of the nonbelieved memory literature has explored autobiographical (Mazzoni et al., 2010; Otgaar et al., 2013) or episodic memories (Clark et al., 2012; Mazzoni et al., 2014). The memories that were challenged in Experiment 3 lacked many of the characteristics of episodic and autobiographical memory in that the items in the scenes were not personal memories and hence, not self-relevant (but see Otgaar et al., 2016). Nonbelieved memories might be more prevalent for episodic and autobiographical memories because these types of memories are personally relevant. It is one thing to challenge another person's memory for an item in a scene, but what about when the memory is personally relevant? Nonbelieved memories may be more likely to occur when memories about ourselves are challenged. In other words, nonbelieved memories may occur because people are less willing to surrender their personal memories.

Research has also shown that performing to-be-remembered actions results in enhanced memory for these actions compared with learning verbal stimuli (known as the 'enactment effect'; Zimmer & Cohen, 2001). Self-performed actions make the stimuli

self-relevant in that they are actions performed by the participants instead of items seen in a scene. Therefore, using self-performed actions we should expect to see stronger recollections for the stimuli which should result in a clearer distinction between belief and recollection than was found in Experiment 3. We expected that using self-performed actions would increase the personal relevance of the recollections and increase initial memory and belief strength for the action prior to any social challenge. We also predicted that following the social feedback, belief ratings should be attenuated below recollection strength ratings.

In Experiment 4, we also introduced an additional condition in which the experimenter provided negative misinformation. In much of the existing literature (Clark et al., 2012; Mazzoni et al., 2014; Otgaar, Howe, Smeets, & Wang, 2016; Otgaar et al., 2013), nonbelieved memories were elicited when the experimenter (rather than a peer confederate) provided information that challenged participants' memories. It is therefore worth examining whether more credible sources of social feedback would have a larger effect on belief ratings. For example, recent research has shown that people often consider other people, such as family and friends, to be a reliable source of information when attempting to verify their memories (Wade, Nash, & Garry, 2014). Research on social influence has manipulated the credibility of the person providing misleading post-event information. For example, Hoffman, Granhag, See, and Loftus (2001) undermined the credibility of a confederate who provided misleading post-event information and found that when the credibility of the confederate was undermined, social influence decreased (see also Gabbert, Memon, & Wright, 2007).

In Experiment 4, we predicted that a challenge made by the experimenter would be perceived by the participant as being more credible, and therefore should have a larger effect on decreasing belief ratings and a subsequent increase in omission errors compared with a challenge made by a peer confederate.

## EXPERIMENT 4

### METHOD

#### *Participants and Design.*

Ninety-seven undergraduate students (77 female) from the University of Portsmouth participated in return for course credit. Ages ranged from 18 to 40 years ( $M_{age} = 19.42$ ,  $SD = 3.81$ ). Data for eight participants were removed prior to analysis; six of these guessed the aim of the experiment or reported that they were suspicious that the other participant was a confederate. Data for two participants were removed due to the experimenter or confederate making an error during testing. The final analysis is based on

89 participants (71 female), aged 18 to 40 years ( $M_{age} = 19.45$ ,  $SD = 3.97$ ). Participants received one course credit for taking part in the experiment.

The current experiment used a between-subjects design and participants were randomly assigned to one of the three conditions; confederate-challenged ( $n = 31$ ), experimenter-challenged ( $n = 27$ ), and control ( $n = 31$ ). We counterbalanced the use of two confederates (one female) in the current experiment.

### *Materials and Procedure.*

On arrival for the experimental session, the confederate and participant were introduced to each other as co-participants (i.e., the participant was led to believe that the confederate was another participant who had signed up for the same session). Both the participant and confederate stood side by side, facing the experimenter and were informed that they would perform a series of actions. The experimenter read aloud the name of each action, and the participant and confederate performed the action simultaneously. Sixty actions (e.g., take three steps forward, touch the floor, wave) were used in the current experiment. These actions were selected from action stimuli reported by Goff and Roediger (1998). Actions not requiring the use of objects were selected for the current experiment. Some of these actions were performed only once (e.g., put your hands on your hips) whereas other actions included a number of repetitive elements (e.g., clap your hands five times). During pilot testing, we asked participants to perform each action for 15 seconds following the instructions used by Goff and Roediger (1998) but found that participants stopped shortly after performing the action. We, therefore, reduced the performance time for each action to 5 seconds. On average, all 60 actions were performed in 5.5 min.

After a four-minute nonverbal number search filler task, the participant and confederate engaged in collaborative recall where the confederate and participants took turns to recall an action they had performed. The participant and confederate took turns to verbally recall actions until 24 actions had been recalled, in total, 12 by the participant and 12 by the confederate. In the confederate-challenged condition, the fourth and ninth actions recollected by the participant were challenged by the confederate saying "I don't remember that action". In the experimenter-challenged condition, the fourth and ninth actions recollected by the participant were challenged by the experimenter saying "That is an incorrect action". Participants in the control condition were not challenged, and actions reported in position four and nine served as control actions. Since in Experiment 4 the confederate made two challenges compared with one challenge in Experiment 3, we made the phrase more natural so that participants did not become suspicious of the confederate.

After a 10-min filler task, completed in a separate room to the confederate, participants then completed an individual free recall task. Participants were presented with a

blank page and were instructed to write down all of the actions that had been performed. There was no time limit for this task.

Participants then provided belief and memory ratings for all 24 actions generated in the collaborative recall task on an 11-point scale (0 = no belief/memory, 10 = strong belief/memory). Belief and memory ratings were given independently, and half of the participants provided belief ratings first, while the other half provided memory ratings first.

## RESULTS AND DISCUSSION

### *Coding*

Accuracy in the free recall task was coded by counting the number of correctly recalled actions. We also coded intrusion errors, where participants had recalled actions that were not performed. Actions challenged by the confederate or experimenter and control actions, were coded as reported if they were recalled, or omitted if they were not reported in the free recall task.

To describe the data and make contrasts, we report 95% confidence intervals for means (Cumming, 2013). All confidence intervals are based on 1,000 bootstrapped samples unless otherwise indicated. Where assumptions were violated, we report the alternative statistics.

### *Recall Performance*

Participants in the control condition ( $M = 34.35$ ,  $SD = 7.53$ , 95% CI [31.68, 37.06]) reported the most correct items, followed by the confederate-challenged condition ( $M = 32.74$ ,  $SD = 5.70$ , 95% CI [30.71, 34.74]). Participants in the experimenter-challenged condition ( $M = 27.33$ ,  $SD = 6.10$ , 95% CI [25.08, 29.56]) reported the fewest correct actions. A one-way ANOVA revealed an effect of condition,  $F(2, 86) = 9.04$ ,  $p < .001$ ,  $\eta^2 = .17$ . Planned contrasts confirmed that participants in the experimenter-challenged condition reported significantly fewer actions than participants in both the confederate-challenged,  $t(86) = 3.16$ ,  $p = .002$ ,  $M_{diff} = 5.41$ , 95% CI [2.30, 8.52] and the control conditions,  $t(86) = -4.16$ ,  $p < .001$ ,  $M_{diff} = -7.02$ , 95% CI [-10.66, -3.38]. The difference between the number of actions recalled by participants in the confederate-challenged and control conditions was not statistically significant  $t(86) = -.98$ ,  $p = .332$ ,  $M_{diff} = -1.61$ , 95% CI [-5.01, 1.78].

Intrusion errors were low across all conditions; confederate-challenged ( $M = 0.06$ ,  $SD = .25$ , 95% CI [.00, .16]), experimenter-challenged ( $M = .11$ ,  $SD = .32$ , 95% CI [.00, .26]) and control ( $M = .13$ ,  $SD = .34$ , 95% CI [.03, .26]). A one-way ANOVA revealed no statistical effect for condition  $F(2, 86) = 0.37$ ,  $p = .694$ ,  $\eta^2 = .001$ .

### Omission Errors

Following Merckelbach and colleagues (2007), we classified participants as making an omission error if they omitted one or two of the challenged or control actions. Table 6 shows the frequency of actions reported and omitted across conditions. A 3 (condition: confederate-challenged, experimenter-challenged and control)  $\times$  2 (report option: reported vs. omitted) Chi-square test revealed a statistically significant association between report option and condition,  $X^2(2, N = 89) = 21.18, p < .001$ , Cramer's  $V = .49$ . We conducted follow-up tests using three 2 (condition)  $\times$  2 (report option: reported vs. omitted) Chi-square tests, correcting for multiple comparisons. There was a statistically significant association between condition (confederate-challenged vs. experimenter-challenged) and report option,  $X^2(1, n = 58) = 17.61, p < .001, \phi = -.55$ , odds ratio = 12.07, 95% CI [3.48, 41.37]. There was also a significant association between condition (control vs. experimenter-challenged), and report option,  $X^2(1, n = 58) = 13.73, p < .001, \phi = .49$ , odds ratio = 8.54, 95% CI [2.59, 28.22]. However, the association between condition (confederate-challenged vs. control condition) and report option was not significant,  $X^2(1, n = 62) = .34, p = .562, \phi = -.07$ , odds ratio = 0.71, 95% CI [0.23, 2.24]. Omission errors were most frequent in the experimenter-challenged condition compared with the confederate-challenged and control condition.

However, because the analysis above does not take into account how many items each participant omitted, we also examined the mean number of challenged and control actions reported by participants across conditions. A one-way ANOVA revealed a significant effect of condition,  $F(2, 51.13) = 21.17, p < .001, \eta^2 = .44$ . Planned contrasts showed that participants in the confederate-challenged condition ( $M = 1.77, SD = .43$ , 95% CI [1.16, 1.90]) reported a similar number of challenged actions as control actions reported by participants in the control condition ( $M = 1.71, SD = .46$ , 95% CI [1.55, 1.87]),  $t(59.60) = .57, p = .669, M_{diff} = .06$ , 95% CI [-.16, .30]. However, in the experimenter-challenged condition, participants reported statistically significantly fewer challenged actions ( $M = .63, SD = .84$ , 95% CI [.33, .96]) than both the confederate-challenged condition,  $t(37.31) = 6.41, p < .001, M_{diff} = 1.15$ , 95% CI [.78, 1.51] and control actions reported by participants in the control condition  $t(39.15) = -5.95, p < .001, M_{diff} = -1.08$ , 95% CI [-1.45, -.71]. Taken together, these results show that participants in the experimenter-challenged condition were more likely to omit the challenged actions in the free recall test than participants in both the confederate-challenged condition and control condition.

**Table 6.** Frequency of Reported and Omitted Actions According to Condition.

Condition	Omitted	Reported
Confederate-challenged	7 (22.5 %)	24 (77.5 %)
Experimenter-challenged	21 (77.5 %)	6 (22.5 %)
Control	9 (29 %)	22 (71 %)



*Belief and Memory Ratings*

A one-way ANOVA, revealed a significant effect of condition on overall belief ratings,  $F(2, 49.28) = 4.23, p < .020, \eta^2 = .14$ . Planned contrasts revealed that participants in the experimenter-challenged condition ( $M = 8.72, SD = 1.95, 95\% \text{ CI } [7.95, 9.49]$ ) rated the challenged actions statistically significantly lower than participants in the confederate-challenged condition ( $M = 9.81, SD = .49, 95\% \text{ CI } [9.63, 9.99]$ ),  $t(28.92) = 2.81, p = .009, M_{diff} = 1.08, 95\% \text{ CI } [.36, 1.81]$ . Participants in the experimenter-challenged condition rated challenged actions statistically significantly lower than control actions rated by the control condition ( $M = 9.85, SD = .57, 96\% \text{ CI } [9.65, 10.06]$ ),  $t(29.82) = -2.92, p = .007, M_{diff} = -1.13, 95\% \text{ CI } [-1.87, -.40]$ . Participants in the confederate-challenged condition however did not rate challenged actions significantly different to control actions rated by participants in the control condition,  $t(58.95) = -.36, p = .721, M_{diff} = -.05, 95\% \text{ CI } [-.32, .22]$ . These results suggest that the challenge made by the experimenter had a greater effect on belief than the confederate's challenge.

Table 7 presents the belief and memory ratings for challenged and control items by report option (reported or omitted). To examine belief ratings for reported and omitted actions, we conducted two 3 (condition: confederate-challenged, experimenter-challenged and control)  $\times$  2 (report option: reported vs. omitted) mixed ANOVAs, one for each of the challenged or control actions. For the first action, we found no effect for condition,  $F(2, 83) = 2.75, p = .07, \eta_p^2 = .06$ , and no effect for report option,  $F(1, 83) = 1.43, p = .235, \eta_p^2 = .02$ . The interaction was not significant,  $F(2, 83) = 2.47, p = .091, \eta_p^2 = .06$ . For the second action, there was also no effect for condition,  $F(2, 83) = 2.40, p = .097, \eta_p^2 = .06$ , and no effect for report option,  $F(1, 83) = 2.36, p = .129, \eta_p^2 = .03$ . The interaction was not significant,  $F(2, 83) = 2.46, p = .092, \eta_p^2 = .06$ . This finding shows that when looking specifically at reported and omitted items there were no effects on belief ratings.

For memory ratings, a one-way ANOVA revealed a significant effect for condition,  $F(2, 51.45) = 4.86, p = .012, \eta^2 = .09$ . Planned contrasts indicated that participants in the confederate-challenged condition ( $M = 9.19, SD = 1.07, 95\% \text{ CI } [8.80, 9.59]$ ) rated challenged actions lower than the control actions rated by participants in the control condition ( $M = 9.69, SD = .85, 95\% \text{ CI } [9.38, 10.00]$ ),  $t(57.17) = -2.03, p = .047, M_{diff} = -.50, 95\% \text{ CI } [-.99, -.01]$ . Participants in the experimenter-challenged condition ( $M = 8.72, SD = 1.57, 95\% \text{ CI } [8.10, 9.34]$ ) also rated challenged actions lower than the control actions rated by the control condition  $t(38.85) = -2.87, p = .007, M_{diff} = -.97, 95\% \text{ CI } [-1.62, -.32]$ . Memory ratings for the challenged actions rated by both the confederate and experimenter-challenged conditions were not significantly different,  $t(44.90) = 1.32, p = .195, M_{diff} = .47, 95\% \text{ CI } [-.23, 1.17]$ . These results suggest that both the confederate and experimenter's challenge had an effect on memory strength, with the experimenter's challenge having a greater effect than the confederate's challenge.

**Table 7.** Mean (SD), and 95% Confidence Intervals (CI) for Belief and Memory Ratings According to Condition and Report Outcome

		Belief			Memory		
Condition	Action	Reported		Omitted		Reported	
		<i>M</i> ( <i>SD</i> )	95% CI	<i>M</i> ( <i>SD</i> )	95% CI	<i>M</i> ( <i>SD</i> )	95% CI
Confederate-challenged	Action 1	9.70 (.82)	[9.37, 9.93]	9.75 (.50)	[9.25, 10.00]	9.59 (.80)	[9.26, 9.85]
	Action 2	9.89 (.42)	[9.71, 10.00]	10.00 (.00)	[10.00, 10.00]	9.32 (1.28)	[8.82, 9.75]
Experimenter-challenged	Action 1	9.71 (.49)	[9.43, 10.00]	7.95 (2.82)	[6.65, 9.10]	9.57 (.79)	[9.00, 10.00]
	Action 2	9.90 (.32)	[9.70, 10.00]	8.53 (2.18)	[7.53, 9.47]	9.90 (.32)	[9.70, 10.00]
Control	Action 1	9.80 (1.00)	[9.40, 10.00]	10.00 (.00)	[10.00, 10.00]	9.92 (.40)	[9.76, 10.00]
	Action 2	9.89 (.42)	[9.71, 10.00]	9.67 (.58)	[9.00, 10.00]	9.86 (.59)	[9.61, 10.00]
						<i>M</i> ( <i>SD</i> )	95% CI
						6.75 (2.22)	[5.25, 9.00]
						7.67 (2.08)	[6.00, 10.00]
						8.10 (1.89)	[7.2, 8.90]
						8.41 (2.09)	[7.41, 9.29]
						8.5 (2.81)	[6.17, 10.00]
						8.67 (2.31)	[6.00, 10.00]

Table 7 shows the belief and memory ratings for challenged and control actions by report option (reported or omitted). As with belief ratings, we conducted two 3 (condition: confederate-challenged, experimenter-challenged and control) x 2 (report option: reported vs. omitted) mixed ANOVAs for memory ratings. There was no effect for condition,  $F(2, 83) = 2.50, p = .089, \eta_p^2 = .06$ , but there was a significant effect for report option  $F(1, 83) = 27.20, p < .001, \eta_p^2 = .25$ . The interaction was not significant  $F(2, 83) = 1.43, p = .244, \eta_p^2 = .03$ . For the second action, there was no significant effect for condition,  $F(2, 83) = 1.18, p = .312, \eta_p^2 = .03$ , but a significant effect for report option,  $F(1, 83) = 12.08, p = .001, \eta_p^2 = .13$ . The interaction was not significant,  $F(2, 83) = 0.09, p = .916, \eta_p^2 < .01$ . These findings are consistent with the pattern of results presented in Table 7. Memory ratings were lower for omitted actions than for reported actions across all conditions.

In sum, as in Experiment 3, we found that a social challenge to participants' memories resulted in omission errors. However, in Experiment 4 only participants challenged by the experimenter made omission errors above the rate of omission errors occurring in the control condition. In Experiment 4 we also found that participants who were challenged by the experimenter reported significantly lower belief ratings than participants in the confederate-challenged condition and control condition. However, for memory, we found that omitted items received significantly lower ratings for memory than items that were reported. Thus, our social challenge delivered by the experimenter appears to have resulted in omission errors and the attenuation of belief, but also the attenuation of recollection.

## GENERAL DISCUSSION

The current research examined whether providing participants with negative misinformation in the form of a challenge from either a confederate or an experimenter resulted in omission errors and whether these omission errors were characterised by attenuated belief ratings. Over two experiments, we demonstrated that a challenge from a confederate (Expt. 3) or an experimenter (Expt. 4) resulted in omission errors. In Experiment 3 we found that participants who had their memory challenged by a confederate were not only more likely to omit the challenged item, but also provided lower belief ratings for the challenged items. In Experiment 4, we also found that participants who were challenged by the experimenter were less likely to report the challenged item and also reported lower belief ratings for the challenged items. However, in both experiments we found that where omission errors occurred, there was a significant decrease in participants' memory ratings for challenged items, suggesting that omission errors

were not only characterised by a decrease in belief strength, but also a decrease in recollection strength.

In both experiments, challenging participants' recollections resulted in omission errors during a subsequent recall task. In Experiment 3, consistent with Merckelbach et al. (2007), participants who had their recollections challenged by a confederate were less likely to report the challenged item on the recall test. However, the percentage of participants in the confederate-challenged condition who made an omission error was much lower (37%) compared with the experiment by Merckelbach et al. (2007) where 72% of participants made at least one omission error. That is, the frequency of omission errors in our experiment was almost 50% lower than in Merckelbach et al. (2007). One possible explanation for this could be because the confederate only challenged one item in our experiment, whereas the confederate in Merckelbach et al. challenged two items. Merckelbach et al. classified participants as 'omitters' in their analysis irrespective of whether they made one or two omission errors. Thus, participants in Merckelbach et al. had two opportunities to be classified as omitters, whereas in our experiment there was only one opportunity to omit a target item. Therefore, our lower rate of omission errors could be explained by the reduced opportunity to make an omission error.

In Experiment 4, the omission error results from Experiment 3 were not replicated, in relation to the confederate-challenged condition. Instead, in Experiment 4, it was the challenge made by the experimenter which resulted in omission errors. Taken together, the results from Experiment 3 and 4 suggest that the relationship between belief, recollection, and omission errors are affected by how the negative misinformation is delivered. In Experiment 3, the confederate used a direct statement to challenge the participant's recollection by specifically questioning whether the item was present in the original scene ("The [name of item] that you mentioned was certainly not present in this picture; otherwise I would have noticed that"). However, in Experiment 4, the confederate used a statement, ("I don't remember that action"), which was less direct, and could have been interpreted by the participant as the confederate not recollecting the action, as opposed to them not actually performing the action. The experimenter's challenge in Experiment 4 ("That is an incorrect action"), resembled the stronger challenge made by the confederate in Experiment 3 in that it specifically called into question that the action had been performed. Therefore, it seems that the strength of the phrase and/or the participants' perception of the strength of the challenge is an important factor in the formation of omission errors. Research on the effect of misleading questions has shown that the specific wording of a misleading question can influence the reports people make about past experiences (e.g., Loftus & Palmer, 1974). Future research should examine how differing degrees of social influence can affect people's belief. For example, how direct the social challenge is could be one variable which might be manipulated. Based on the findings from this research, it might be predicted that

more direct feedback which makes a specific challenge would result in a higher frequency of omission errors compared with an indirect challenge.

In both experiments, we found that omission errors were rated lower for both belief and memory strength. While the finding that omission errors received lower belief ratings is in line with our expectations, we had not predicted memory ratings to also be low. Previous research (Clark et al., 2012; Mazzoni et al., 2014) has also found that negative misinformation which resulted in nonbelieved memories also had an effect on memory ratings. However, in Clark et al. (2012) and Mazzoni et al. (2014), their manipulation had a greater effect on belief ratings and the change in memory ratings was only small (and not significant). With respect to the current findings, one possible explanation could be that our manipulation challenged not only participants' belief, but also their recollection. Scoboria et al. (in press) argue that what they called 'weak' nonbelieved – characterised by low belief and recollection ratings - are more likely to occur following manipulations which question the recollective qualities of the memory.

In Experiment 4 we found that participants in the experimenter-challenged condition reported lower belief ratings than participants in both the confederate-challenged and control conditions. Participants in the experimenter-challenged condition also reported fewer correct actions in the free recall task, suggesting that the challenge made by the experimenter could have caused participants to raise their criterion for reporting recollections. Challenges from both the confederate in Experiment 3 and the experimenter in Experiment 4 resulted in participants being less likely to report recollections that had been challenged. These findings suggest that it is not the production of nonbelieved memories that results in omission errors. Instead, our results fit best within the model proposed by Koriat and Goldsmith (1996). That is, people decide to withhold memories about which they are unsure: the attenuation of belief is not a necessary precondition for omission errors. Koriat and Goldsmith's model suggests that a recollection will be withheld if the cost of reporting the recollection outweighs the probability of the recollection being correct. Although we cannot rule out that participants felt that they had to be as accurate as possible, our data suggest that participants' decision to report or omit their recollections was based on new information obtained from the confederate or experimenter, and not the situational demands.

Looking at the data in Table 7 it is clear that belief and memory ratings were, overall, very high in Experiment 4. Participants were asked to provide belief and memory ratings only a short time after performing the actions. Previous research aimed at eliciting nonbelieved memories has employed a longer delay between encoding and delay (e.g., Clark et al., 2012; Mazzoni et al., 2014). Future research should increase the delay between encoding and challenging the recollection. It could be hypothesised that as the delay increases, participants could become more susceptible to the challenge by the confederate or the experimenter.

One of the novel aspects of Experiment 4 is the use of self-performed actions. We predicted that by performing the actions, recollections would be more self-relevant

than the recollections of items in Experiment 3. Self-relevance is an important aspect of episodic and autobiographical memories, and past research on nonbelieved memories has focused predominantly on episodic and autobiographical memories. In Experiment 4, it is not clear whether personal relevance was important, since participants in the confederate-challenged condition did not omit challenged actions compared with either the control condition or the confederate-challenged condition in Experiment 3. Future research should examine whether self-relevance is an important factor in the retention of recollection for events that individuals have since ceased to believe to have occurred.

There are practical implications to the current research. Previous research has shown that omission errors occur following negative misinformation from a confederate acting as a co-witness (Merckelbach et al., 2007). While we replicated these findings in Experiment 3, in Experiment 4 we were not able to replicate this finding. This could be, as predicted, that the self-relevant actions performed in Experiment 4 are more difficult to challenge than the items in Experiment 3. That is, when the memory to be challenged is of personal relevance, negative misinformation from a peer appears to be ineffective. However, when negative misinformation from a more reliable source, the experimenter, was introduced then our results suggest that this is effective (Otgaar et al., 2016).

In sum, in contrast to research suggesting a relationship between nonbelieved memories and omission errors, we did not find that nonbelieved memories led to increased omission errors in the present experiments. These results suggest that the link between belief, recollection, and the reporting of memories is rather more complex than is often assumed. A key recommendation emerging from our findings is that future research place greater emphasis on the interplay between the role of various forms of social feedback and its impact on belief, recollection, and the retrieval of autobiographical memories. There are many situations where people share and discuss their memories, and the current findings raise important questions about how other people can both support and undermine our recollection of the past.



# Chapter 5

## Thesis General Discussion





The core aim of the experiments presented in this thesis was to examine whether there was an association between nonbelieved memories and omission errors. Specifically, the main hypothesis was that omission errors would occur when individuals attenuated their belief about past experiences. The current research represents the first attempt to test this hypothesis experimentally. In this discussion, an overview of the results from the four experiments is presented first, before the theoretical and practical implications are considered. In the final sections, some of the limitations of the current research and suggestions for future research are explored.

## SUMMARY OF FINDINGS

This thesis started with an experiment in which nonbelieved memories were experimentally induced. This was done to show how relatively easy nonbelieved memories can be formed and to demonstrate that social feedback –which was used in some of the experiments in this thesis – can be used to successfully manipulate belief in occurrence. One of the most interesting and consistent findings from the other four experiments presented in this thesis was that belief was only attenuated when participants' memories were challenged. In both Experiments 1 and 2, negative misinformation was introduced to participants in the form of withheld items. In both experiments, there was no effect of withholding items on the belief ratings for those items. However, in Experiments 3 and 4, a 'social' challenge was introduced whereby participants received negative misinformation from a confederate. In both Experiments 3 and 4, this social feedback resulted in the attenuation of belief ratings for the omitted items. This finding is of particular interest because previous research (e.g., Mazzoni et al., 2010; Scoboria et al. 2014) has found that people who have a naturally occurring nonbelieved memory most commonly report social feedback (e.g., being told by someone else that the event did not occur) as the main reason that led them to attenuate belief in that particular memory. In addition, research that has elicited nonbelieved memories in the laboratory has also tended to use social manipulations (such as the experimenter telling participants that they have falsely remembered performing an action; Clark et al., 2012; Mazzoni et al., 2014).

Another interesting finding from these experiments relates to the frequency of omission errors. In previous research, omission errors were elicited by re-presenting participants with a previously seen stimuli (e.g., a series of drawings depicting a couple going on a date ), with some items (in this case one of the drawings) withheld (Wright et al., 2001), or by having a confederate challenge a participant's memory (Merckelbach et al., 2007). In Experiments 1 and 2, similar to the procedure used by Wright et al. (2001), omission errors were elicited by initially presenting participants with scenes showing a collection of household items (e.g., a kitchen scene showing a fork, a knife, a plate). Participants were then shown those scenes again but with some items from the scenes

(e.g., the fork) omitted. Although this procedure did result in some omission errors for the omitted items such errors were scarce. Using a procedure similar to Merckelbach et al. (2007), in Experiments 3 and 4 participants had their memories challenged by either a confederate (Expts. 3 & 4) or the experimenter (Expt. 4). In Experiments 3 and 4 we found a higher rate of omission errors than in Experiments 1 and 2. In fact, the frequency of omission errors in Experiments 3 and 4 was comparable to other omission error studies (e.g. Merckelbach et al., 2007). Again, the main difference between Experiments 1 and 2 and Experiments 3 and 4 is the use of a confederate to challenge participant's recollection in the latter experiment. This finding suggests that omission errors occur more readily following a social challenge.

In both Experiments 3 and 4 we found that social feedback which challenged participants' memories resulted in both omission errors and the attenuation of belief. While this was in line with our expectations, we did, however, also find that the social feedback had a decreasing effect on participants' recollection ratings for challenged items. While this finding is interesting, it is also interesting that recollection ratings decreased along with belief ratings.

In summary, our results suggest that there is an important link between omission error and the attenuation of belief, but only in situations where participants received challenging social information. Below, we discuss the findings from the current research and the theoretical implications of our findings.

## THEORETICAL IMPLICATIONS

The research presented in this thesis is grounded in the idea that recollecting an event and believing that an event occurred are dissociable components of remembering the past (Mazzoni & Kirsch, 2002; Scoboria et al., 2014; Scoboria et al., 2004). The results of the experiments reported here do not demonstrate conclusively that belief and recollection can be dissociated when focussing on omission errors. In Experiments 3 and 4, challenged items and actions received lower belief ratings. Previous research has found that people with naturally occurring nonbelieved memories most commonly report that they attenuated their belief when they received social feedback (Mazzoni et al., 2010; Scoboria et al., 2015). Also, researchers have used social feedback from an experimenter to elicit nonbelieved memories in laboratory settings (Clark et al., 2012; Mazzoni et al., 2014; Otgaar et al., 2013). Social feedback therefore seems to be a critical factor associated with the attenuation of belief.

We also found, however, that challenged items and actions also received recollection ratings which were lower than for items that were not challenged. This finding that both belief and recollection for challenged items were rated lower for both belief and recollection than non-challenged items suggests that the social feedback had an effect on participants' ratings of both belief and recollection. While this finding was surprising

since we had expected challenged memories to be characterised by high recollection ratings accompanied by low belief ratings, previous research has also found that social challenges result in the attenuation of both belief and recollection (Clark et al., 2012; Mazzoni et al., 2014). However, participants in the research conducted by Clark et al., (2012) and Mazzoni et al., (2014) were presented with video evidence which could have enhanced their memory for them performing the actions. Thus, previous research may have used a procedure which resulted in more robust memories than in our research.

It is perhaps not surprising that social feedback is most commonly associated with attenuating belief in recollections, given that autobiographical memory provides the material required for conversations with others (Bluck, Alea, Habernas, & Rubin 2005). How we discuss our memories with other people can reshape our memories of the past. For example Marsh (2007) makes a distinction between *recalling* and *retelling* previously experienced events. The distinction Marsh (2007) emphasises is that recalling is an accurate and detailed account of the past, while retelling is dependent on the goals of the person telling the memory. Often when we share our memories with other people, we reshape the story to fit with the audience, as observed by Bartlett (1932) with participants' retellings of the story 'The War of the Ghosts'. Sharing our memories with other people also provides an opportunity for other people to challenge our memories (Gabbert et al., 2006; Merckelbach et al., 2007). Therefore our recollections and beliefs are subject to constant revision and change in light of conversations with other people. It is also not surprising that memories are subject to revision following social feedback given that research has found that people often rely on other people to verify their memories. For example, recent research has shown that people often consider other people, such as family and friends, to be a reliable source of information when attempting to verify their memories (Wade et al., 2014). Thus, social feedback might be the most commonly reported reason for people to attenuate their belief because memories are often discussed with other people.

We also found that omission errors were more likely to occur following a social challenge (Expts. 3 & 4) compared with a non-social challenge (Expts. 1 & 2). While previous research had found that social challenges resulted in a high frequency of omission errors, 72% in Merckelbach et al. (2007), previous research had also found that 56% of participants made an omission errors using a non-social paradigm (Wright et al., 2001). However, the procedure used by Wright et al. (2001) was not entirely non-social. Recall that Wright et al. asked participants to copy a series of drawings depicting a couple going on a date. When participants returned a week later, they were shown a copy of the drawings to use to tell a story. However, participants were told that this copy of the drawings was done by another participant. Thus, while there was not a direct social feedback from another participant, there was an implicit social element in this experimental design. It is not possible to know whether this social element had an effect on the frequency of omission errors. However, in Experiment 1 and 2 reported in this thesis, participants were not given any information suggesting a social element. In Experi-

ments 1 and 2 we found omission errors only occurred rarely. There is, therefore, scope for further research examining the impact of social influence on the occurrence of omission errors given that previous research using explicit (Merckelbach et al., 2007) and implicit (Wright et al., 2001) social feedback has found omission errors.

### PRACTICAL IMPLICATIONS

The results of the experiments reported here support previous research (e.g. Merckelbach et al., 2007), showing that socially challenging peoples' memories result in omission errors. Given that research has shown that it is not uncommon for eyewitnesses to discuss a witnessed event with other witnesses (Skagerberg & Wright, 2008) there is an obvious concern that social feedback could result in witnesses omitting important information when interviewed by police. If a witness discusses a co-witnessed event with another witness at the scene and mentions a detail that was not seen by the other witness, a challenge from the other witness could result in an omission error. The consequence of the witness making an omission error could be that investigators are unable to follow up a lead which is relevant to their investigation. The question then is whether there is a way to encourage people to report memories that have been challenged by other people. For example, the Cognitive Interview (Fisher & Geiselman, 1992) instructs witnesses to only report what they saw. Therefore, one question for future research is whether adopting good interviewing techniques such as the Cognitive Interview will reduce the frequency of omission errors. Further research might also explore whether warnings or specific instructions might also be beneficial with respect to eliciting information which has been 'weakened' by a challenge.

The current research may also be relevant to cases where people claim to have been the victim of sexual abuse but later retract their claim (see for example Ost, *in press*). In such cases, these 'retractors' initially report that they were abused, but then, for some reason, withdraw their claim. There are of course a number of reasons that someone alleging sexual abuse would come to retract their claim. For example, the alleged victim might have been told by the alleged abuser that they did not abuse them or perhaps the claim was without merit, based on suggestive memory recovery techniques used by some therapists (Ost, Costall & Bull, 2001). Our results show that challenging people's recollections of past events can make them less likely to be reported in subsequent memory tests. What is not clear is whether our findings would replicate in a situation where a highly personal memory is the focus of the challenge. Of course, there are significant ethical issues in designing experimental research to address research questions surrounding highly personal and traumatic memories. Nonetheless, future work might consider how best to design methodologies to capture omission errors in real-world situations.

### *Limitations*

One of the limitations of these experiments is that, like most other lab investigations of nonbelieved memories and omission errors, ecological validity was low. In reality, challenges to a person's memory are more likely to occur in a conversational setting as opposed to a simple statement or withholding an item from a previously seen scene in a highly controlled environment. This raises the possibility that social feedback could operate via a number of factors which were not present in our experiments. For example, when people discuss their memories in real world settings, a challenge by another person is likely to be followed by a discussion. Indeed, if someone challenged my memory of writing this thesis I would not simply accept the challenge and stop believing that I had in fact written it. Instead, I would want to question the challenge and understand why the challenger disputes my recollection. In our experiments we prevented participants asking questions about why it appeared their recollection was inaccurate. Previous research (Clark et al., 2012; Mazzoni et al., 2014) challenged participants' memories using a debriefing which provided participants with an explanation for why they had falsely remembered the challenged memories. Future research should allow participants the opportunity to discuss their challenged recollections with their challenger to determine whether, with more information and rationalisation, belief is attenuated and the frequency of omission errors increases.

The personal relevance of a memory might influence how willing we are to re-appraise our memory. In Experiment 4 we asked participants to perform simple actions. The purpose of using self-performed actions was to increase the personal relevance of the stimuli. Naturally occurring nonbelieved memories, such as the one reported by Piaget (1951) tend to be for highly personal and self-relevant events (e.g., almost being kidnapped). It is questionable how personally relevant memories of performing a simple action in a laboratory setting really are. While it would be interesting for future research to challenge participants recollections of true, personally relevant events from their past, there are ethical issues to consider. After all, it is one thing to implant a false memory for having being in a hot-air balloon and then to remove the false memory (Wade et al., 2002), but it is an entirely different issue to challenge peoples' personal memories of the past. Perhaps the use of a more interactive activity in which people must complete certain actions to achieve a goal might offer one opportunity to study more self-relevant recollections. It might be predicted that using such a procedure, the more self-relevant the recollections are (e.g., memory for an achievement), the more likely people will be to retain the recollection while attenuating their belief that the event occurred.

## FUTURE RESEARCH DIRECTIONS

The results of the present research reiterate the importance of social processes in the attenuation of belief. There is clear evidence converging on the idea that social influence is important in the attenuation of belief (e.g., Mazzoni et al., 2010; Scoboria et al., 2014), and further research is needed to understand the social processes involved in the elicitation of nonbelieved memories. Previous research has shown that the credibility of the person providing social feedback can influence how willing people are to accept the social feedback. For example, Hoffman et al. (2001) undermined the credibility of a confederate who provided participants with misleading post-event information and found that participants were less susceptible to the misleading post-event information (see also Gabbert et al., 2007). Interestingly, children appear to be more susceptible to misleading post-event information when it is provided by their parents, who, presumably, they consider credible (Poole & Lindsay, 2001). While Experiments 3 and 4 of the current research examined social feedback from a peer-confederate or an experimenter, future research should examine influence other people could have. For example, if a parent was to challenge one of their children's memories of the past, would this cause the attenuation of belief more than when a stranger challenges their memory? Since research has shown that asking other people is a common method of verifying memories (Wade et al., 2014), it might be predicted that a relative would be considered more reliable and credible than someone unknown to the rememberer.

Another important question which also needs to be addressed in future work relates to the potential of important individual differences between participants who have a nonbelieved memory and those who do not. While research has found that one in five people report having a nonbelieved memory (Mazzoni et al., 2010), it seems plausible to argue that more people have had their memories of the past challenged. Thus, there are interesting questions to be asked about why some people develop nonbelieved memories while others do not. Indeed, research has shown that some people continue to have a strong recollection of an event even when their recollection is challenged. For example, Sheen, Kemp and Rubin (2001) found that twins and even same-sex friends can often dispute the ownership of a memory. One such example of a disputed memory is from a twin sample where each had a recollection of being sent home from school for a uniform violation. However, while both of them remembered it being them who was sent home, this event actually only occurred to one member of the pair. Such recollections show that in the presence of social feedback, some people defend their memories. Similar findings have been found in the nonbelieved memories literature (Otgaar et al., 2013). Future research should examine the individual differences of those participants who relinquish belief compared with those who defend their original memory even in the face of social feedback challenging their recollection. It might be predicted that factors such as suggestibility and compliance could explain why some people are more willing to attenuate their belief following a social challenge. Research has found that

suggestibility and compliance are factors associated with false confessions (Gudjonsson, 1989) which have also been associated with changes in beliefs about the past (Scoboria et al., 2014).

Finally, future research should examine the effect of delay on the elicitation of non-believed memories and omission errors. Previous research which attempted to elicit nonbelieved memories (Clark et al., 2012; Mazzoni et al., 2014) and omission errors (Wright et al., 2001) used a procedure which allowed a greater amount of time to pass between encoding the original stimuli and being exposed to the misleading information (but see Merckelbach et al., 2007). In naturally occurring nonbelieved memories, there are often many years between the original event and the time at which the person attenuated their belief that the event occurred. For example, Mazzoni et al. (2010) found that nonbelieved memories were, on average for events at age seven years old, and belief was attenuated at around age 15 years old. Thus, around eight years had passed between the original event occurring and the time at which the event was re-appraised. In experimental settings, the delay between the original event occurring and the challenge has been as long as a few days (Clark et al. 2012; Mazzoni et al., 2014) but more typically in experimental research, the delay is not manipulated and the retrieval interval is only several minutes. The experiments presented in this thesis did not allow for an extended time delay. This comparison raises an interesting question: does a decrease in activation of memories over time result in greater susceptibility to misinformation? Research has shown that participants are more susceptible to the effects of socially administered misleading post-event information when a greater amount of time has passed (Paterson, Kemp & Forgas, 2009). It, therefore, could be predicted that as the amount of time between the original event and the social feedback increases, so too could the participant's susceptibility to the social feedback.

## CONCLUDING REMARKS

While the results of the current research only show a weak link between the elicitation of nonbelieved memories and the occurrence of omission errors, there is evidence to suggest that when recollections are socially challenged, people do attenuate their belief for the challenged recollection. We did, however, observe a decrease in recollection ratings which was not observed for non-challenged items. Thus, while our results do support the previous speculation about the association between nonbelieved memories and omission errors, our results do not show belief to have been dissociated from recollection substantially. The research presented in this thesis makes a useful contribution to the literature examining the social effects on memory. Participants in our research did become less likely to report memories when they had been challenged socially. These findings are largely consistent with previous research and demonstrate that other people can have a significant impact on what we remember about the past. The results



## Chapter 5

of this research raise some interesting questions about the influence of other people on our recollections and beliefs about the past. Our findings show that social challenges influence both belief and recollection, and under some circumstances also result in omission errors.

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# Valorisation Addendum

## RELEVANCE

The research presented in this thesis could have relevance to the many situations where we rely on our memory. As explored in Chapter 1, human memory is not always as reliable as we might hope. Memory does not work like a video camera and our memories are prone to distortion. Memory errors within legal settings can have a significant impact on both the individuals who are wrongly imprisoned, but also on society as the real perpetrator is not apprehended. The results reported here provide further insight into human memory.

More specifically, Experiments 3 and 4 examine the important issue of having our memories challenged by other people. In legal settings, witnesses, victims and even offenders can have their memories for past events challenged by investigators. Our findings demonstrate that challenges by other people can result in these memories being withheld in subsequent memory tests. In terms of the real-world, withheld information could limit the amount of available information for investigators.

## TARGET GROUPS

Given the relevance of this research to investigative interviewing, it seems plausible to argue that this research is most relevant to investigators. Investigators should be aware of the consequences of challenging the memories of other people. However, the findings reported here would require significantly more research before concrete recommendations could be made to investigators operating in the real world.

## ACTIVITIES AND PRODUCTS

To promote the results of this research, I have presented these research findings at international conferences which have a specific focus on the application of applied research in memory and cognition.



## INNOVATION

Research into human memory can rarely be considered innovative. But, with that having said, there are a number of investigative interviewing tools which are used by agencies. For example, police in the UK use an interview protocol based on the Cognitive Interview. Also, based on the Cognitive Interview Geiselman, Fisher, MacKinnon, & Holland, 1985; Fisher & Geiselman, 1992, another investigative interview tool is the Self-Administered Interview<sup>®</sup> (Gabbert, Hope & Fisher, 2009). Given further research on the topic of this thesis, it is possible that these results could contribute to changes in investigative interviewing tools.

## SCHEDULE AND IMPLEMENTATION

As mentioned above, errors in eyewitness memory can result in innocent people going to prison. It could also be argued that rushing to make changes to investigative interviewing process could also increase the risk of miscarriages of justice. Therefore, before any recommendations can be made, the results of this thesis need to be tested further. Furthermore, given the nature of the stimuli used in this research, additional research is needed using ecologically valid stimuli. Therefore, the innovative benefits of this research will be slowly realised through additional research.

## Appendix

### Ethical Approval

Each of the four experiments presented in this thesis received ethical approval from the University of Portsmouth's Science Faculty Ethics Committee (SFEC). Below, the letter of favourable opinion is attached for each of the experiments reported in this thesis.

Experiment 1



Faculty of Science  
University of Portsmouth  
St Michael's Building  
White Swan Road  
PORTSMOUTH  
PO1 2DT

Date 12/12/13

**FAVOURABLE OPINION**

**Protocol Title: Undermining belief to induce omissions from memory reports**

Dear Andrew,

Thank you for resubmitting your revised protocol for ethical review and for the clarifications provided.

Your responses have been reviewed and I am pleased to inform you that your application has been given a favourable opinion by the Science Faculty Ethics Committee. Thus, no further action is required on your part.

Please notify us in the future of any substantial amendments that may be required and send us a final study report.

Good luck with the study.

Best wishes,

A handwritten signature in black ink, appearing to read 'J. Kaminski'.

Dr. Juliane Kaminski  
(Dept) Science Faculty Ethics Committee

CC -  
Dr Chris Markham – Chair of SFEC  
Sci.fac@port.ac.uk  
Holly Shawyer – Faculty Administrator

## Experiment 2



Faculty of Science  
University of Portsmouth  
St Michael's Building  
White Swan Road  
PORTSMOUTH  
PO1 2DT

Date 12/12/13

### FAVOURABLE OPINION

**Protocol Title: Undermining belief to induce omissions from memory reports**

Dear Andrew,

Thank you for resubmitting your revised protocol for ethical review and for the clarifications provided.

Your responses have been reviewed and I am pleased to inform you that your application has been given a favourable opinion by the Science Faculty Ethics Committee. Thus, no further action is required on your part.

Please notify us in the future of any substantial amendments that may be required and send us a final study report.

Good luck with the study.

Best wishes,

A handwritten signature in black ink, appearing to read 'J. Kaminski'.

Dr. Juliane Kaminski  
(Dept) Science Faculty Ethics Committee

CC -  
Dr Chris Markham – Chair of SFEC  
Sci.fac@port.ac.uk  
Holly Shawyer – Faculty Administrator

Experiment 3



Faculty of Science  
University of Portsmouth  
St Michael's Building  
White Swan Road  
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PO1 2DT

[andrew.clark1@port.ac.uk](mailto:andrew.clark1@port.ac.uk)  
03/03/15

Science Faculty Ethics Committee

Protocol Title: Undermining belief to induce omissions from memory reports, SFEC 2014-039A  
Date received PI submission: 27/02/15  
Date Reviewed: 03/03/15

FAVOURABLE OPINION – SFEC 2014-039A

Dear Mr Clark,

Thank you for your submission for ethical review. Having completed their review, members of the Science Faculty Ethics Committee have reached a Favourable opinion of your proposed research.

Please notify the committee of any substantial amendments to the proposed procedures, send an annual report to the committee regarding study progress and a final study report once the study has concluded. Please send these to [ethics-sci@port.ac.uk](mailto:ethics-sci@port.ac.uk).

Thank you for your submission and the Committee wishes you well with your study.

*Dr Chris Markham – Chair of SFEC*

A handwritten signature in dark ink, appearing to read 'Chris Markham'.

CC -  
*Holly Showyer – Faculty Administrator*

If you would like to offer any feedback on the Science Faculty Ethics Committee process please email [ethics-sci@port.ac.uk](mailto:ethics-sci@port.ac.uk), to be forwarded to the Chair

Experiment 4



Science Faculty Ethics Committee  
Science Faculty Office  
University of Portsmouth  
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T: 023 9284 3379  
[ethics-sci@port.ac.uk](mailto:ethics-sci@port.ac.uk)

Date 15<sup>th</sup> September 2015

**FAVOURABLE ETHICAL OPINION**

Study Title: Nonbelieved memories for actions

Reference Number: SFEC 2014-039B (Please quote this in any correspondence)

Thank you for resubmitting your protocol amendment application to the Science Faculty Ethics Committee (SFEC), for ethical review, following the favourable opinion letter for SFEC 2014-039A, dated 3<sup>rd</sup> March 2015, in accordance with current procedures<sup>1</sup>.

I am pleased to inform you that the SFEC is content to grant a favourable ethical opinion of the above research on the basis described in the submitted documents listed at Annex A, and subject to standard general conditions<sup>2</sup>.

Please note that the favourable opinion of SFEC does not grant permission or approval to undertake the research. Management permission or approval must be obtained from any host organisation, including the University of Portsmouth or supervisor, prior to the start of the study.

Wishing you every success in your research

Yours sincerely,

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<sup>1</sup> Procedures for Ethical Review, Science Faculty Ethics Committee, University of Portsmouth, October 2012 (to be updated).

<sup>2</sup> After ethical review – Guidance for researchers (Please read).

